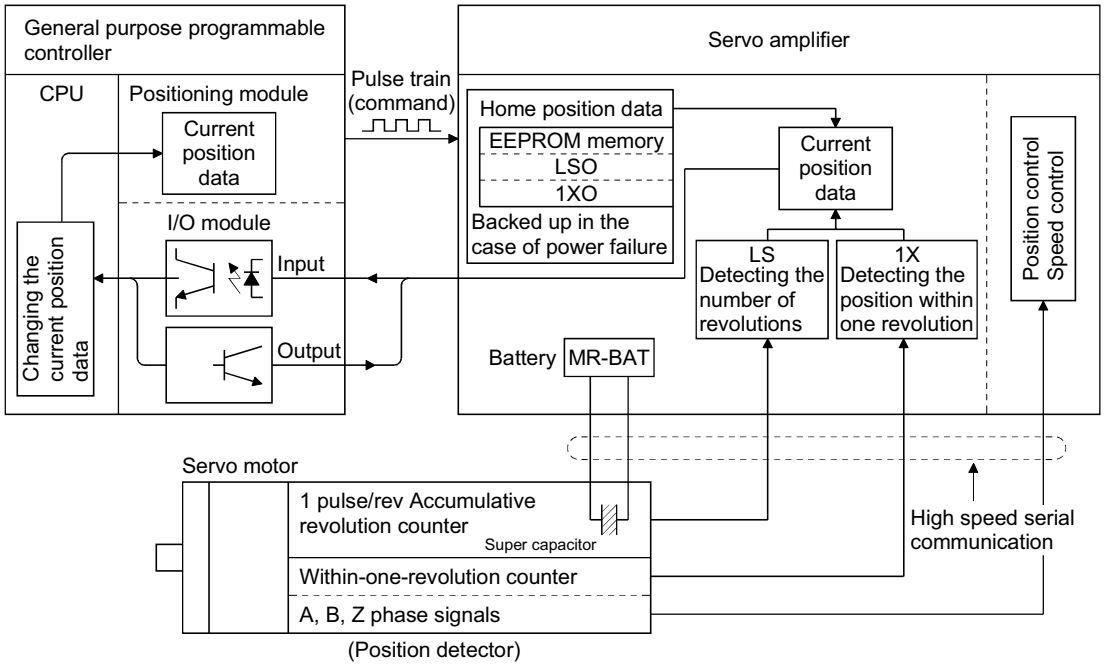
15. ABSOLUTE POSITION DETECTION SYSTEM

CAUTION	・If an absolute position erase alarm (AL.25) has occurred, always perform home position setting again. Not doing so can cause runaway.

15.1 Outline

15.1.1 Features

For normal operation, as shown below, the encoder consists of a detector designed to detect a position within one revolution and a cumulative revolution counter designed to detect the number of revolutions.
The absolute position detection system always detects the absolute position of the machine and keeps it battery-backed, independently of whether the general-purpose programming controller power is on or off. Therefore, once the home position is defined at the time of machine installation, home position return is not needed when power is switched on thereafter.
If a power failure or a fault occurs, restoration is easy.
Also, the absolute position data, which is battery-backed by the super capacitor in the encoder, can be retained within the specified period (cumulative revolution counter value retaining time) if the cable is unplugged or broken.



15.1.2 Restrictions

The absolute position detection system cannot be configured under the following conditions. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, choose incremental in parameter No.1.
(1) Speed control mode, torque control mode.
(2) Control switch-over mode (position/speed, speed/torque, torque/speed).
(3) Stroke-less coordinate system, e.g. rotary shaft, infinitely long positioning.
(4) Changing of electronic gear after home position setting.
(5) Use of alarm code output.

15.2 Specifications

(1) Specification list

Item	Description
System	Electronic battery backup system
Battery	1 piece of lithium battery (primary battery, nominal + 3.6V) Type: MR-BAT or A6BAT
Maximum revolution range	Home position ± 32767 rev.
(Note 1) Maximum speed at power failure	500r/min
(Note 2) Battery backup time	Approx. 10,000 hours (battery life with power off)
(Note 3) Data holding time during battery replacement	2 hours at delivery, 1 hour in 5 years after delivery
Battery storage period	5 years from date of manufacture

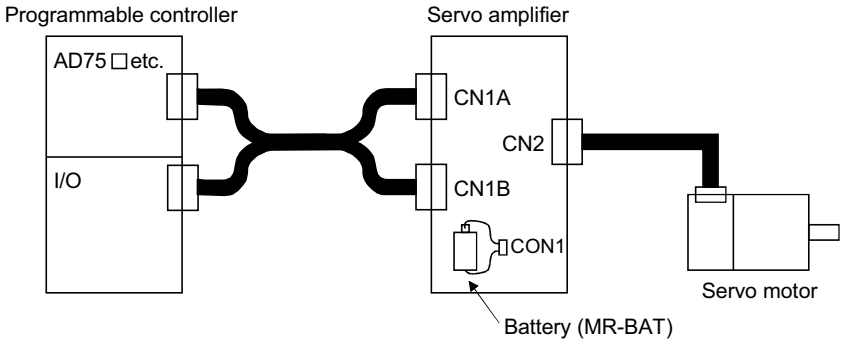
Note: 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.

2. Time to hold data by a battery with power off. It is recommended to replace the battery in three years independently of whether power is kept on or off.

3. Period during which data can be held by the super capacitor in the encoder after power-off, with the battery voltage low or the battery removed, or during which data can be held with the encoder cable disconnected.
Battery replacement should be finished within this period.

(2) Configuration

Positioning module	I/O module
AD71・AD71S2・AD71S7 A1SD71S2・A1SD71S7 AD75□ A1SD75□	AX40・41・42 AY40・41・42
FX-1PG・FX-1GM FX(E)-20GM・FX-10GM	FX2-32MT



(3) Parameter setting

Set "1□□□" in parameter No.1 to make the absolute position detection system valid.

Parameter No. 1

1	–	–	–

Selection of absolute position detection system
0: Incremental system
1: Absolute position detection system

15.3 Battery installation procedure

⚠ WARNING	・Before starting battery installation procedure, make sure that the charge lamp is off more than 10 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock.

POINT

The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions:

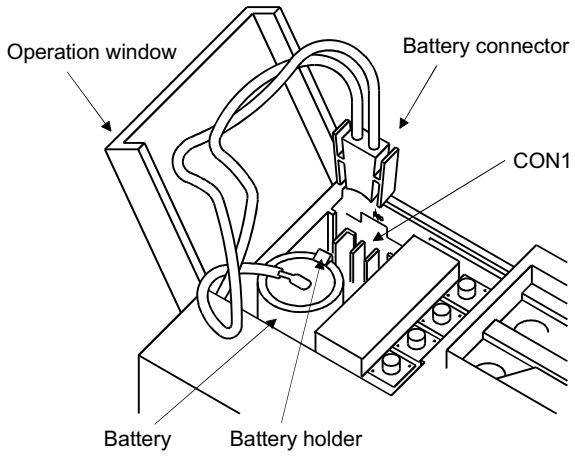
・Ground human body and work bench.

・Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

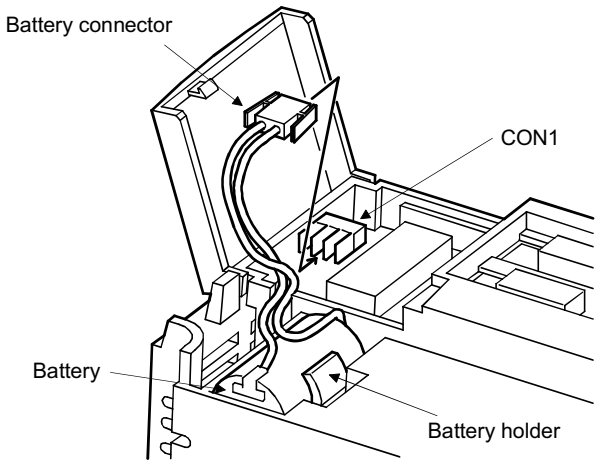
(1) Open the operation window. (When the model used is the MR-J2S-200A・MR-J2S-350A or more, also remove the front cover.)

(2) Install the battery in the battery holder.

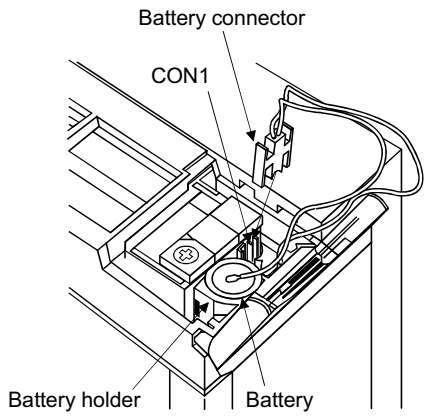
(3) Install the battery connector into CON1 until it clicks.



For MR-J2S-100A or less

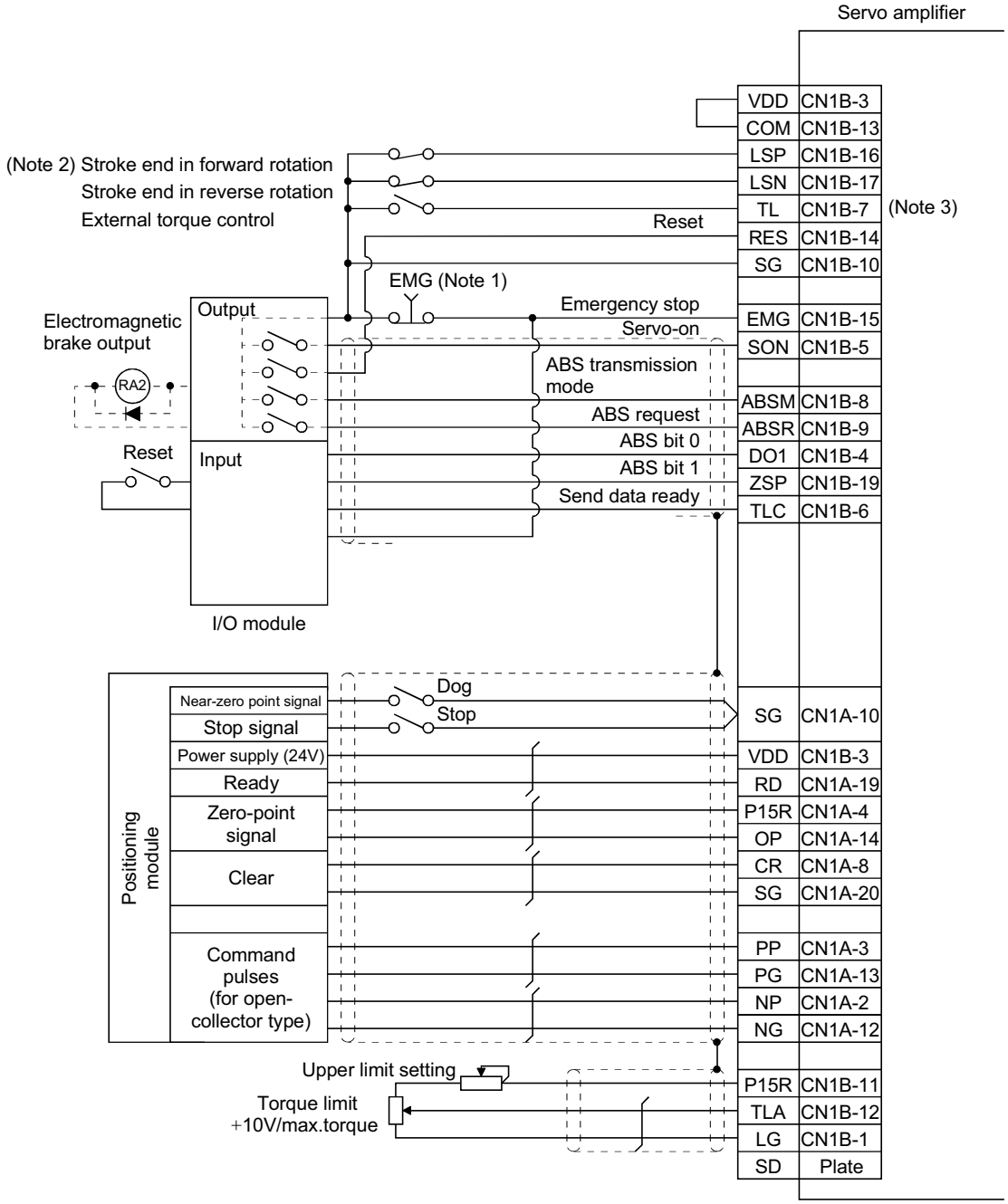


For MR-J2S-200A・MR-J2S-350A



For MR-J2S-500A・MR-J2S-700A

15.4 Standard connection diagram



Note: 1. Always install the emergency stop switch.

2. For operation, always short the forward/reverse rotation stroke end (LSN/LSP) with SG.

3. When using the torque limit signal (TL), set "□□□4" in parameter No.46 to assign TL to pin CN1B-7.

15.5 Signal explanation

When the absolute position data is transferred, the signals of connector CN1 change as described in this section. They return to the previous status on completion of data transfer. The other signals are as described in Section 3.3.2.
For the I/O interfaces (symbols in the I/O Category column in the table), refer to Section 3.6.

Signal name	Code	Pin No.	Function/Application	I/O category	Control mode
ABS transfer mode	ABSM	(Note) CN1B-8	While ABSM is shorted by connection to SG, the servo amplifier is in the ABS transfer mode, and the functions of ZSP, TLC, and D01 are as indicated in this table.	DI-1	P (Position control)
ABS request	ABSR	(Note) CN1B-9	ABSR-SG are shorted to request the ABS data in the ABS transfer mode.	DI-1	
ABS bit 0	D01	CN1B-4	Indicates the lower bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, the circuit between D01 and SG is closed.	DO-1	
ABS bit 1	ZSP	CN1B-19	Indicates the upper bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, the circuit between ZSP and SG is closed.	DO-1	
Send data ready	TLC	CN1B-6	Indicates that the data to be sent is being prepared in the ABS transfer mode. At the completion for the ready state, the circuit between TLC and SG is closed.	DO-1	
Home position setting	CR	CN1A-8	When CR-SG are shorted, the position control counter is cleared and the home position data is stored into the non-volatile memory (backup memory).	DI-1	

Note: When "Used in absolute position detection system" is selected in parameter No. 1, pin CN1B-8 acts as the ABS transfer mode (ABSM) signal and pin CN1B-9 as the ABS request (ABSR) signal. They do not return to the original signals if data transfer ends.

15.6 Startup procedure

(1) Battery installation.

Refer to Section 15.3 installation of absolute position backup battery.

(2) Parameter setting

Set "1 □□□"in parameter No. 1 of the servo amplifier and switch power off, then on.

(3) Resetting of absolute position erase alarm (AL.25)

After connecting the encoder cable, the absolute position erase alarm (AL.25) occurs at first power-on. Leave the alarm as it is for a few minutes, then switch power off, then on to reset the alarm.

(4) Confirmation of absolute position data transfer

When the servo-on signal is turned on, the absolute position data is transferred to the programmable controller. When the ABS data is transferred properly:

(a) The ready output (RD) turns on.

(b) The programmable controller/ABS data ready contact (M3 for A1SD71, M99 for 1PG) turns on.

(c) The servo configuration software ABS data display window (refer to Section 15.9) and programmable controller side ABS data registers (D3, D4 for A1SD71, D106, D107 for 1PG) show the same value (at the home position address of 0).
If any warning such as ABS time-out warning (AL.E5) or programmable controller side transfer error occurs, refer to Section 15.10 or Chapter 10 and take corrective action.

(5) Home position setting

The home position must be set if:

(a) System setup is performed;

(b) The servo amplifier has been changed;

(c) The servo motor has been changed; or

(d) The absolute position erase alarm (AL.25) occurred.

In the absolute position system, the absolute position coordinates are made up by making home position setting at the time of system setup.
The motor shaft may misoperate if positioning operation is performed without home position setting. Always make home position setting before starting operation.
For the home position setting method and types, refer to Section 15.7.3.

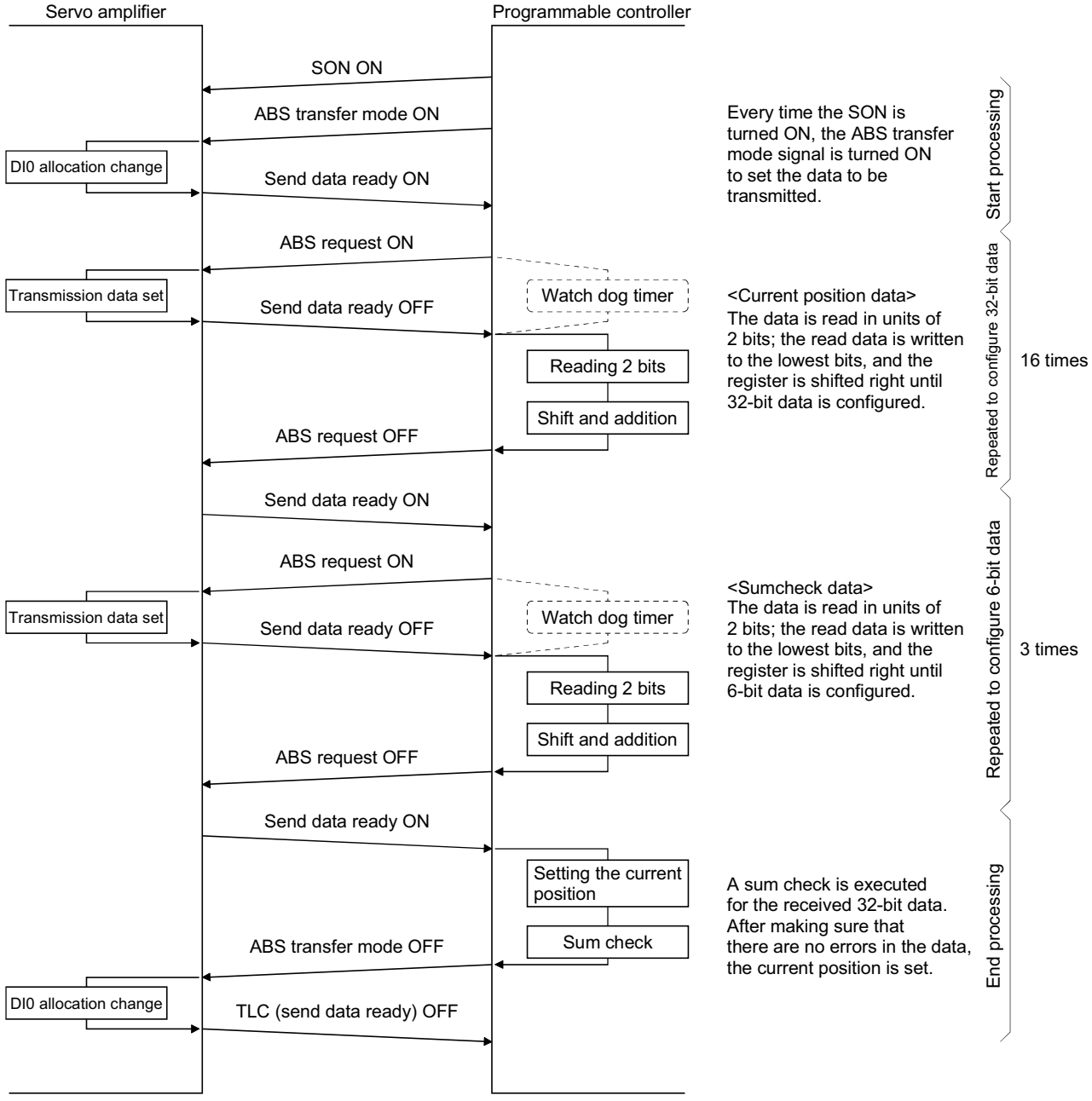
15.7 Absolute position data transfer protocol

POINT

- After switching on the ABS transfer mode (ABSM), turn on the servo-on signal (SON). When the ABS transfer mode is off, turning on the servo-on signal (SON) does not switch on the base circuit.

15.7.1 Data transfer procedure

Each time the SON signal is turned ON (when the power is switched ON for example), the programmable controller reads the position data (present position) of the servo amplifier.
Time-out monitoring is performed by the programmable controller.

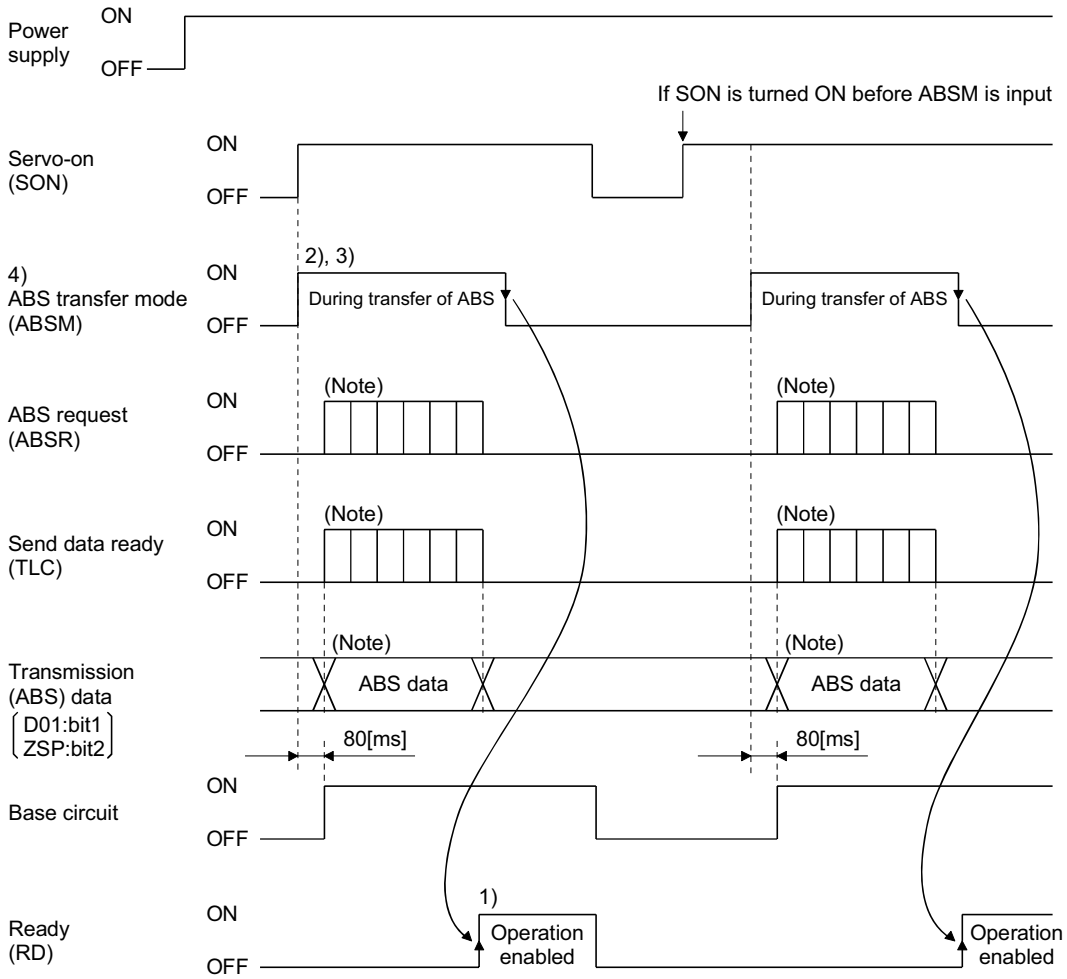


15.7.2 Transfer method

The sequence in which the base circuit is turned ON (servo-on) when it is in the OFF state due to the servo-on signal (SON) going OFF, an emergency stop, or alarm, is explained below. In the absolute position detection system, every time the servo-on (SON) signal is turned on, the ABS transfer mode (ABSM) signal should always be turned on to read the current position in the servo amplifier to the controller. The servo amplifier transmits to the controller the current position latched when the ABS transfer mode (ABSM) signal switches from OFF to ON. At the same time, this data is set as a position command value inside the servo amplifier. Unless the ABS transfer mode signal (ABSM) is turned ON, the base circuit cannot be turned ON.

(1) At power-on

(a) Timing chart



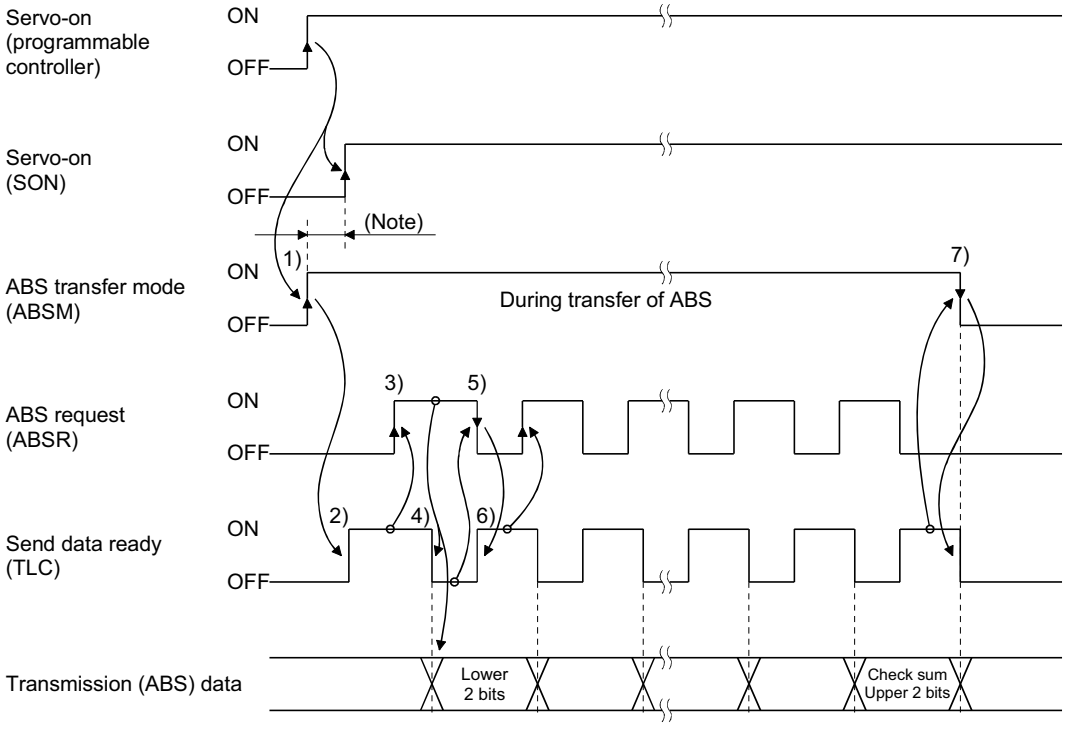
Note: For details, refer to (1) (b) in this section.

1) The ready signal (RD) is turned ON when the ABS transfer mode signal (ABSM) is turned OFF after transmission of the ABS data.
   While the ready signal (RD) is ON, the ABS transfer mode signal (ABSM) input is not accepted.
2) Even if the servo-on (SON) signal is turned ON before the ABS transfer mode signal (ABSM) is turned ON, the base circuit is not turned ON until the ABS transfer mode signal (ABSM) is turned ON.
   If a servo alarm has occurred, the ABS transfer mode signal (ABSM) is not received.
   The ABS transfer mode signal (ABSM) allows data transmission even while a servo warning is occurring.
3) If the ABS transfer mode signal (ABSM) is turned OFF during the ABS transfer mode, the ABS transfer mode is interrupted and the time-out error (AL.E5) occurs.
4) The functions of output signals such as ZSP, TLC, D01, and INP change depending on the ON/OFF state of the ABS transfer mode signal (ABSM).
   Note that if the ABS transfer mode signal (ABSM) is turned ON for a purpose other than ABS data transmission, the output signals will be assigned the functions of ABS data transmission.

Symbol	Pin No.	Output signal	
		ABS transfer mode (ABSM): OFF	ABS transfer mode (ABSM): ON
(Note) D01	CN1B-4	Positioning completion	ABS data bit 0
ZSP	CN1B-19	Zero speed	ABS data bit 1
TLC	CN1B-6	During torque limit control	Send data ready
(Note) INP	CN1A-18	Positioning completion	ABS data bit 0

Note: CN1B-4 and CN1A-18 output the same signals. (To enter the positioning completion signal into INPS of the AD75, connect CN1A-18.)

(b) Detailed description of absolute position data transfer



Note: If the servo-on signal (SON) is not turned ON within 1 second after the ABS transfer mode signal (ABSM) is turned ON, an SON time-out warning (AL.EA) occurs. This warning, however, does not interrupt data transmission. It is automatically cleared when the servo-on (SON) signal is turned ON.

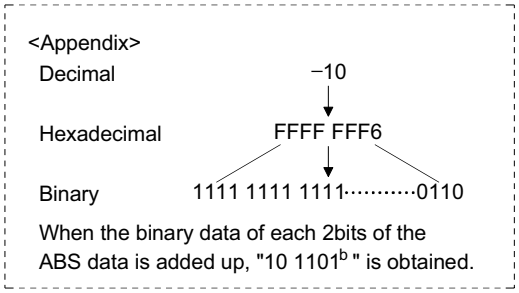
1) The programmable controller turns ON the ABS transfer mode signal (ABSM) and servo-on signals (SON) at the leading edge of the internal servo-on signal.
2) In response to the ABS transfer mode signal, the servo detects and calculates the absolute position and turns ON the send data ready (TLC) signal to notify the programmable controller that the servo is ready for data transmission.
3) After acknowledging that the ready to send (TLC) signal has been turned ON, the programmable controller turns ABS request (ABSR) ON.
4) In response to ABS request (ABSR), the servo outputs the lower 2 bits of the ABS data and the ready to send (TLC) signal in the OFF state.
5) After acknowledging that the ready to send (TLC) signal has been turned OFF, which implies that 2 bits of the ABS data have been transmitted, the programmable controller reads the lower 2 bits of the ABS data and then turns OFF the ABS request (ABSR).
6) The servo turns ON the ready to send (TLC) so that it can respond to the next request.
   Steps 3) to 6) are repeated until 32-bit data and the 6-bit check sum have been transmitted.
7) After receiving of the check sum, the programmable controller turns the ABS transfer mode signal (ABSM) OFF.
   If the ABS transfer mode signal (ABSM) is turned OFF during data transmission, the ABS transfer mode is interrupted.

(c) Checksum

The check sum is the code which is used by the programmable controller to check for errors in the received ABS data. The 6-bit check sum is transmitted following the 32-bit ABS data.
At the programmable controller, calculate the sum of the received ABS data using the ladder program and compare it with the check sum code sent from the servo.
The method of calculating the check sum is shown. Every time the programmable controller receives 2 bits of ABS data, it adds the data to obtain the sum of the received data. The check sum is 6-bit data.
Negative data is available for the FX-1PG and unavailable for the A1SD71.

Example: ABS data: −10 (FFFFFFF6H)

$$
\begin{array}{rr}
 & 10^{b} \\
 & 01^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
+) & 11^{b} \\
\hline
 & 101101^{b}
\end{array}
$$



Therefore, the check sum of "−10" (ABS data) is "2Db"

(2) Transmission error

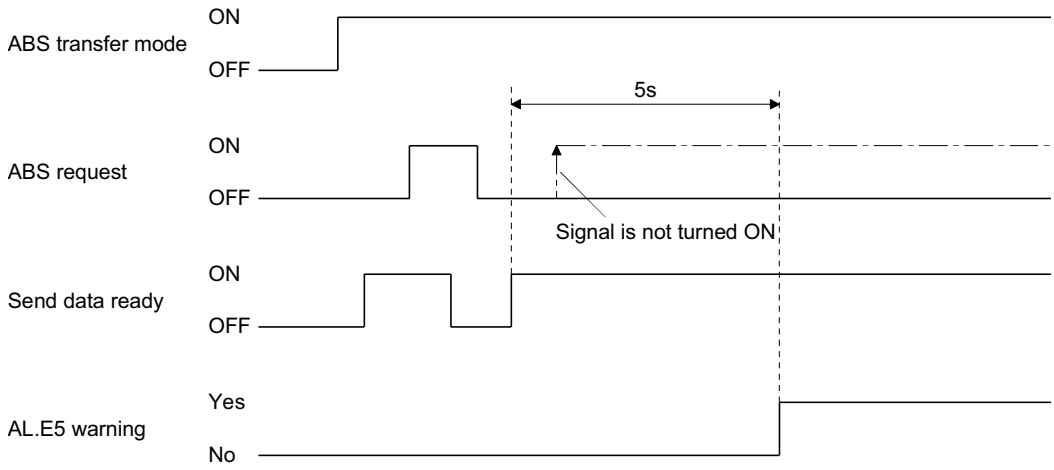
(a) Time-out warning(AL.E5)

In the ABS transfer mode, the time-out processing shown below is executed at the servo. If a time-out error occurs, an ABS time-out warning (AL.E5) is output.

The ABS time-out warning (AL.E5) is cleared when the ABS transfer mode (ABSM) changes from OFF to ON.

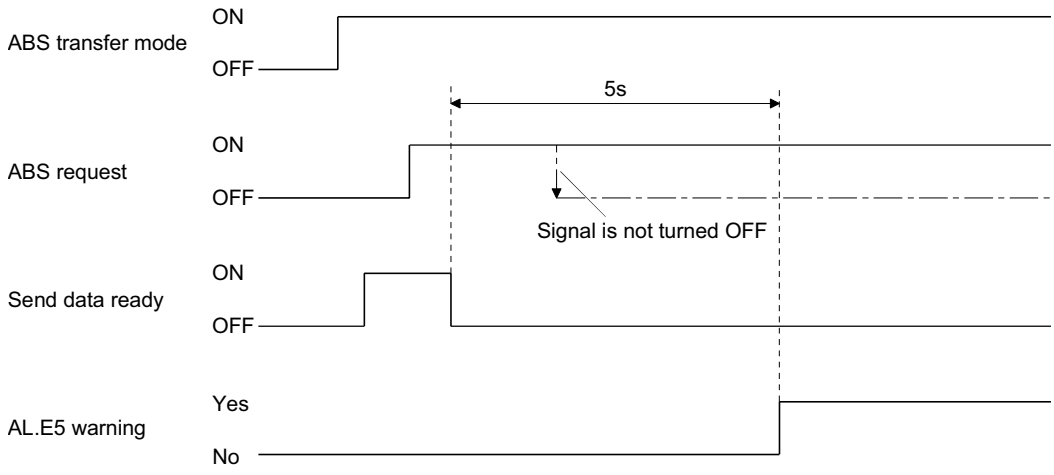
1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned ON by the programmable controller within 5s after the send data ready signal is turned ON, this is regarded as a transmission error and the ABS time-out warning (AL.E5) is output.



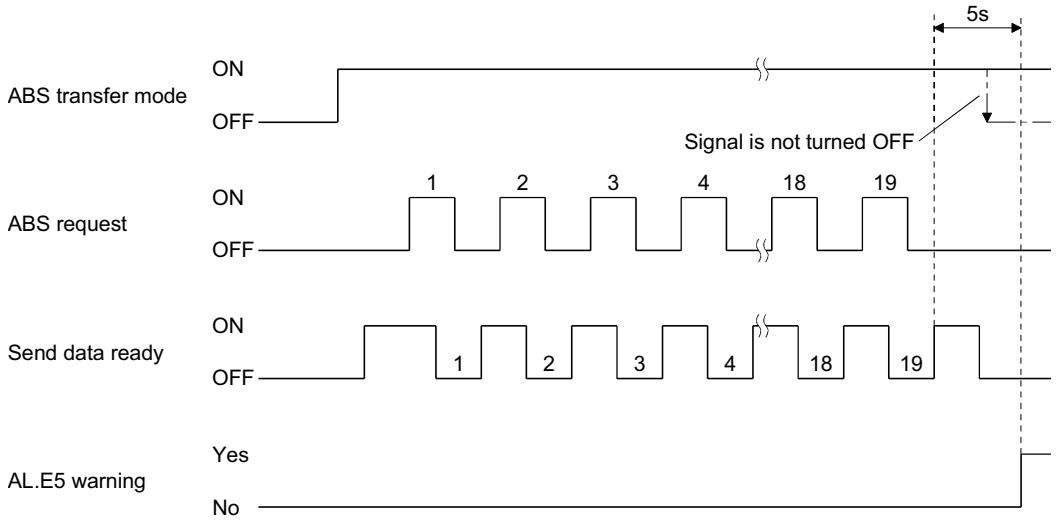
2) ABS request ON-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned OFF by the programmable controller within 5s after the send data ready signal is turned OFF, this is regarded as the transmission error and the ABS time-out warning (AL.E5) is output.



3) ABS transfer mode finish-time time-out check

If the ABS transfer mode signal is not turned OFF within 5s after the last ready to send signal (19th signal for ABS data transmission) is turned ON, it is regarded as the transmission error and the ABS time-out warning (AL.E5) is output.



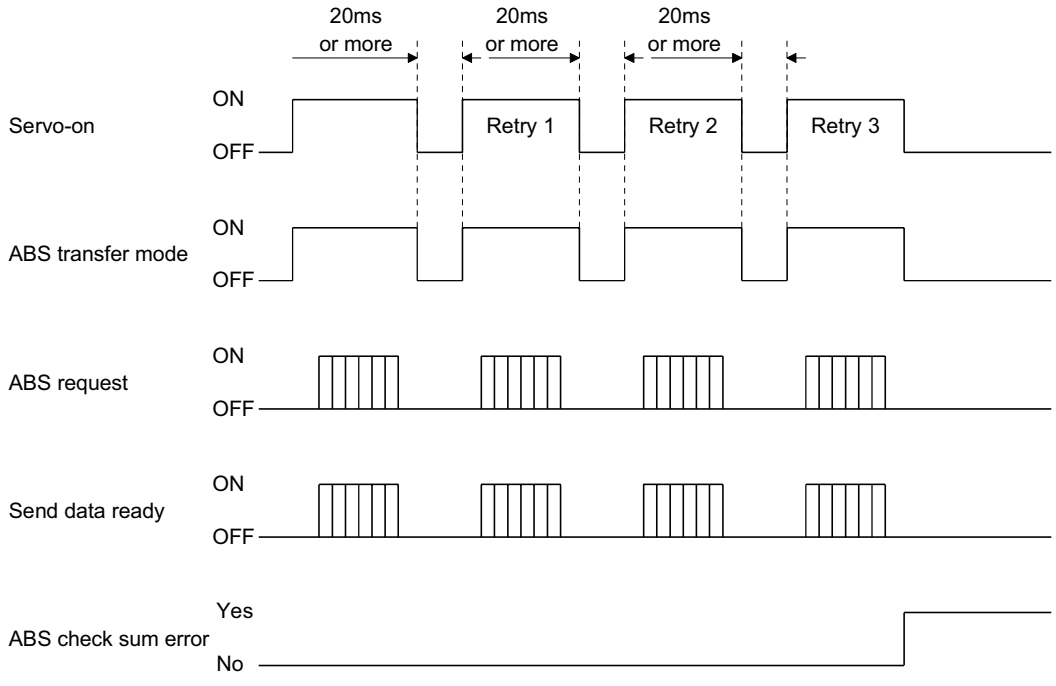
(b) Check sum error

If the check sum error occurs, the programmable controller should retry transmission of the ABS data.

Using the ladder check program, turn OFF the ABS transfer mode (ABSM) and servo-on (SON) signals once. Turn them ON again after an OFF time of longer than 20 ms.

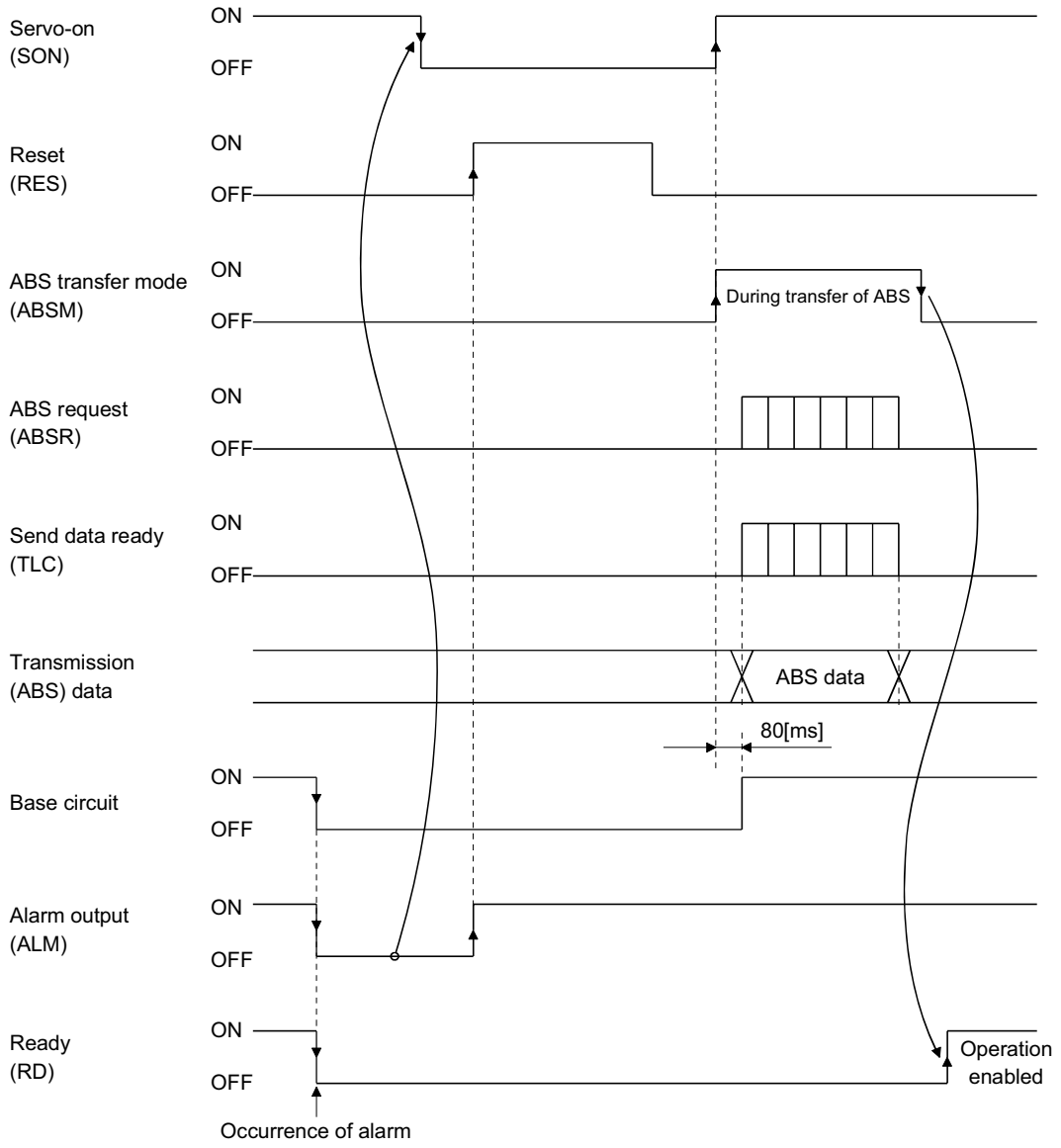
If the ABS data transmission fails to end normally even after retry, regard this situation as an ABS check sum error and execute error processing.

The start command should be interlocked with the ABS data ready signal to disable positioning operation when an check sum error occurs.



(3) At the time of alarm reset

If an alarm occurs, turn OFF the servo-on (SON) signal by detecting the alarm output (ALM).
If an alarm has occurred, the ABS transfer mode signal (ABSM) cannot be accepted.
In the reset state, the ABS transfer mode signal (ABSM) can be input.



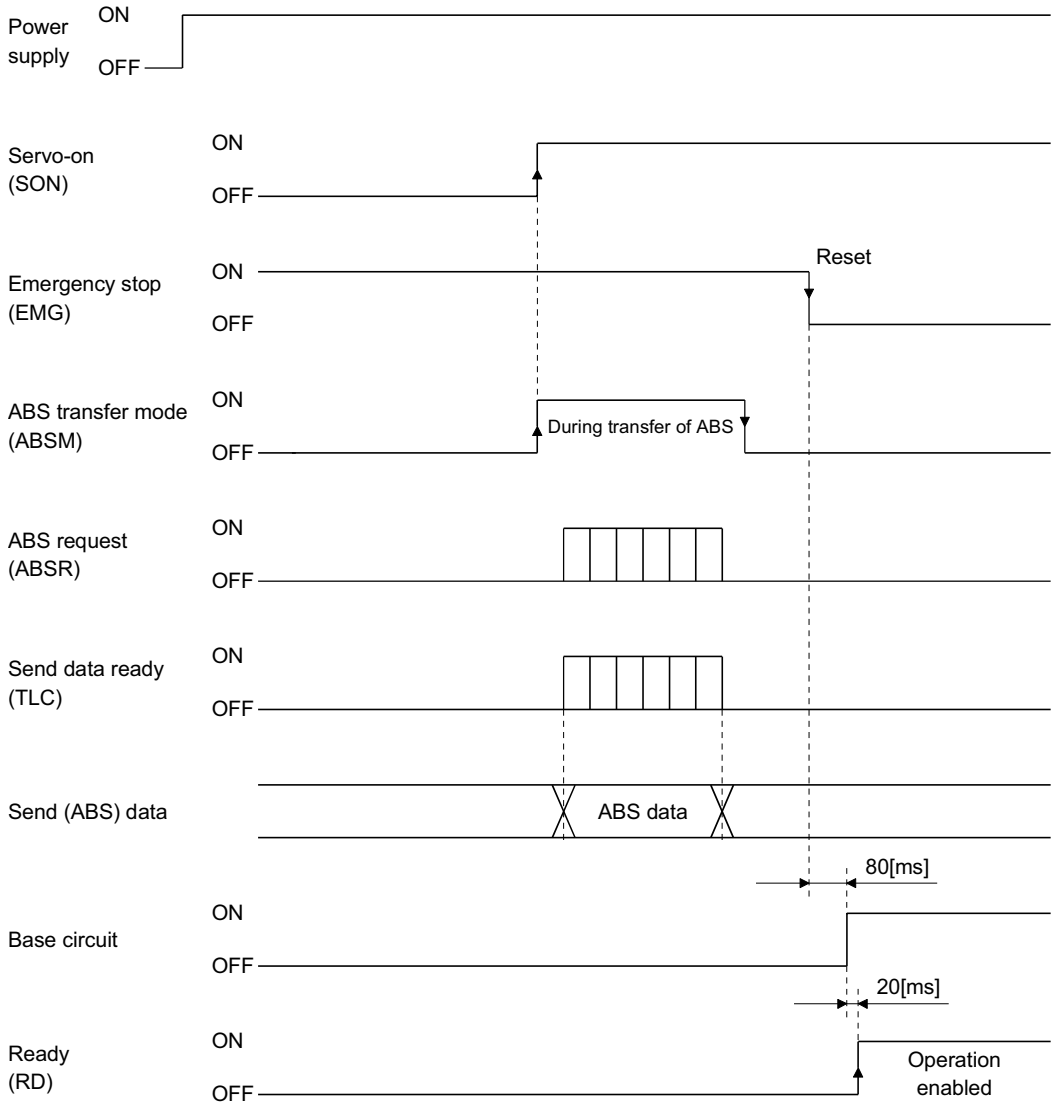
(4) At the time of emergency stop reset

(a) If the power is switched ON in the emergency stop state

The emergency stop state can be reset while the ABS data is being transferred.

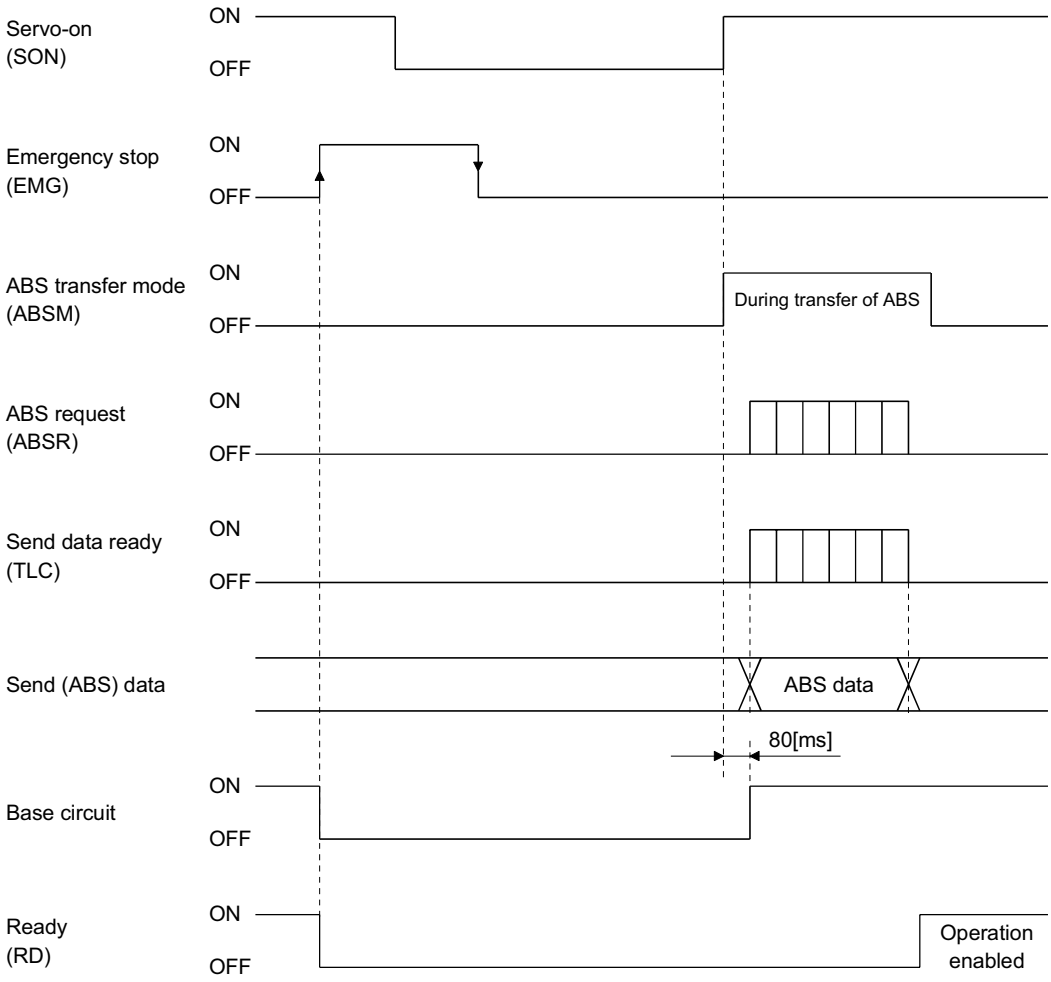
If the emergency stop state is reset while the ABS data is transmitted, the base circuit is turned ON 80[ms] after resetting. If the ABS transfer mode signal (ABSM) is OFF when the base circuit is turned ON, the ready signal (RD) is turned ON 20[ms] after the turning ON of the base circuit. If the ABS transfer mode signal (ABSM) is ON when the base circuit is turned ON, it is turned OFF and then the ready signal (RD) is turned ON. The ABS data can be transmitted after the emergency stop state is reset.

The current position in the servo amplifier is updated even during an emergency stop. When servo-on (SON) and ABS transfer mode (ABSM) are turned ON during an emergency stop as shown below, the servo amplifier transmits to the controller the current position latched when the ABS transfer mode (ABSM) switches from OFF to ON, and at the same time, the servo amplifier sets this data as a position command value. However, since the base circuit is OFF during an emergency stop, the servo-lock status is not encountered. Therefore, if the servo motor is rotated by external force or the like after the ABS transfer mode (ABSM) is turned ON, this travel is accumulated in the servo amplifier as droop pulses. If the emergency stop is cleared in this status, the base circuit turns ON and the motor returns to the original position rapidly to compensate for the droop pulses. To avoid this status, reread the ABS data before clearing the emergency stop.



(b) If emergency stop is activated during servo-on

The ABS transfer mode signal (ABSM) is permissible while in the emergency stop state. In this case, the base circuit and the ready signal (RD) are turned ON after the emergency stop state is reset.



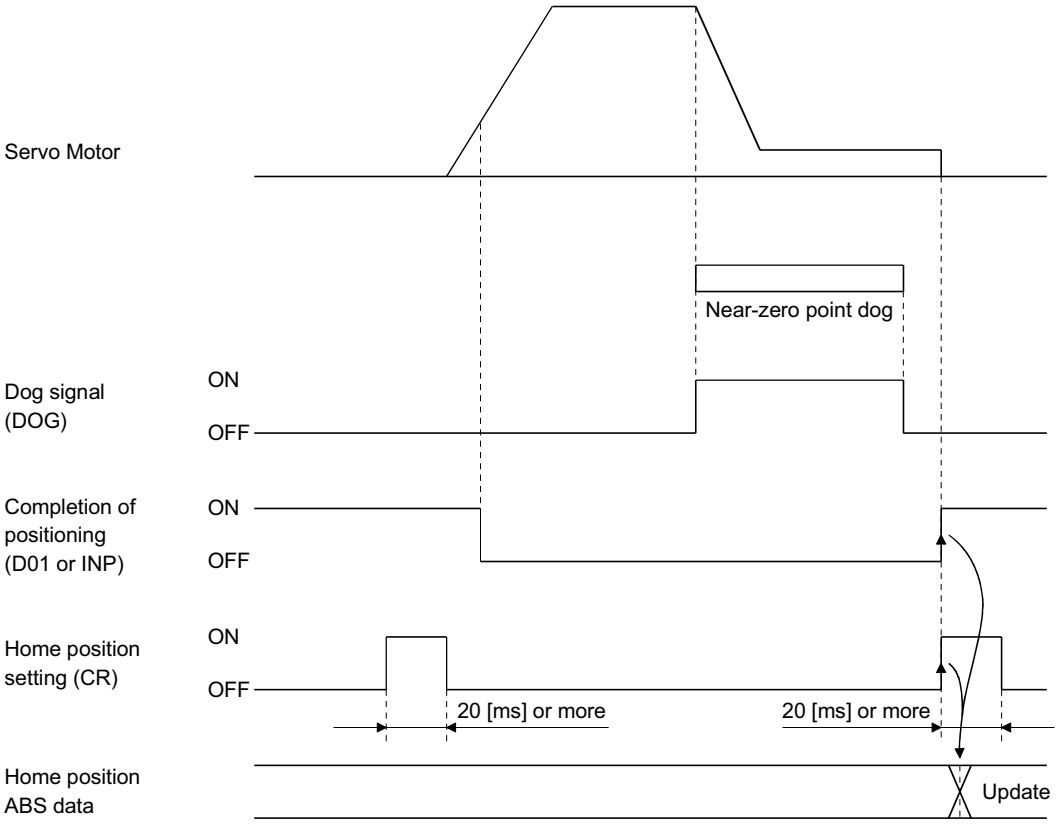
15.7.3 Home position setting

(1) Dog type home position return

Preset a home position return creep speed at which the machine will not be given impact. On detection of a zero pulse, the home position setting signal (CR) is turned from off to on. At the same time, the servo amplifier clears the droop pulses, comes to a sudden stop, and stores the stop position into the non-volatile memory as the home position ABS data.

The home position setting signal should be turned on after it has been confirmed that the in-position (D01 or INP) is on. If this condition is not satisfied, the home position setting warning (AL.96) will occur, but that warning will be reset automatically by making home position return correctly.

The number of home position setting times is limited to 1,000,000 times.

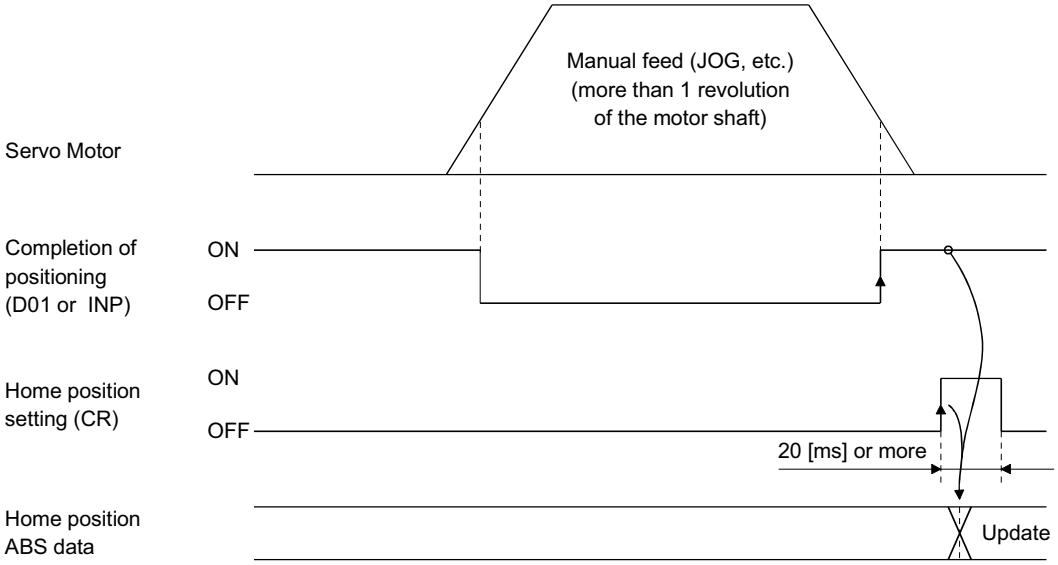


(2) Data set type home position return

Move the machine to the position where the home position is to be set by performing manual operation such as jog operation to turn the motor shaft more than one revolution. When the home position setting signal (CR) is on for longer than 20ms, the stop position is stored into the non-volatile memory as the home position ABS data.

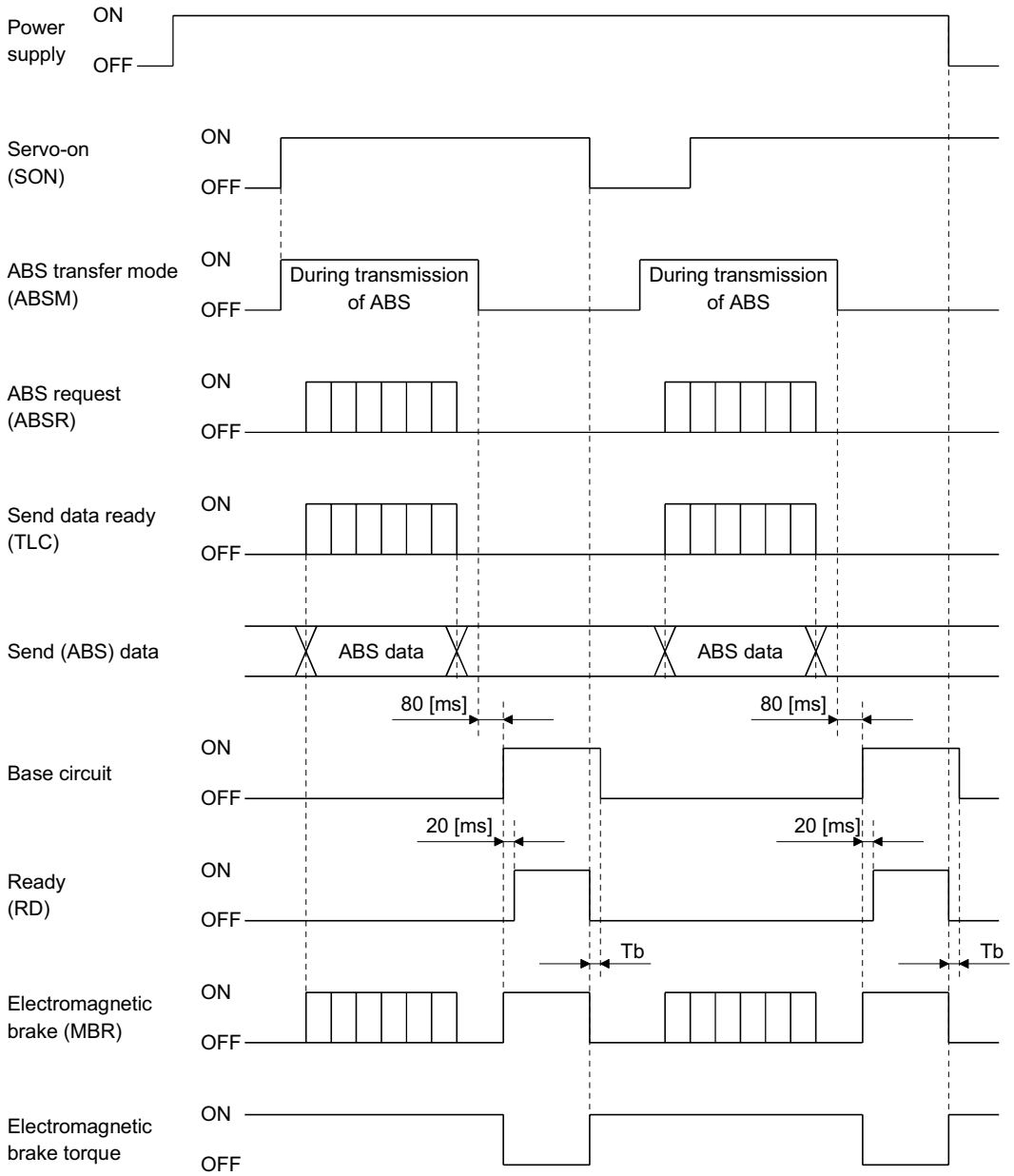
The home position setting signal should be turned on after it has been confirmed that the in-position (D01 or INP) is on. If this condition is not satisfied, the home position setting warning (AL.96) will occur, but that warning will be reset automatically by making home position return correctly.

The number of home position setting times is limited to 1,000,000 times.



15.7.4 Use of servo motor with electromagnetic brake

The timing charts at power on/off and servo-on (SON) on/off are given below.
Preset "□□1□" in parameter No. 1 to make the electromagnetic brake interlock signal (MBR) usable.
When the ABS transfer mode is ON, the electromagnetic brake interlock (MBR) is used as the ABS data bit 1.
Hence, make up an external sequence which will cause the electromagnetic brake torque to be generated by the ABS mode (ABSM) and electromagnetic brake interlock signals.



15.7.5 How to process the absolute position data at detection of stroke end

The servo amplifier stops the acceptance of the command pulse when stroke end (LSP・LSN) is detected, clears the droop pulses to 0 at the same time, and stops the servo motor rapidly.
At this time, the programmable controller keeps outputting the command pulse. Since this causes a discrepancy between the absolute position data of the servo amplifier and the programmable controller, a difference will occur between the position data of the servo amplifier and that of the programmable controller.
To prevent this difference in position data from occurring, do as described below. When the servo amplifier has detected the stroke end, perform jog operation or the like to clear the stroke end. After that, switch the servo-on signal off once, then on again, or switch the power off once, then on again. This causes the absolute position data of the servo amplifier to be transferred to the programmable controller, restoring the normal data.

15.8 Examples of use

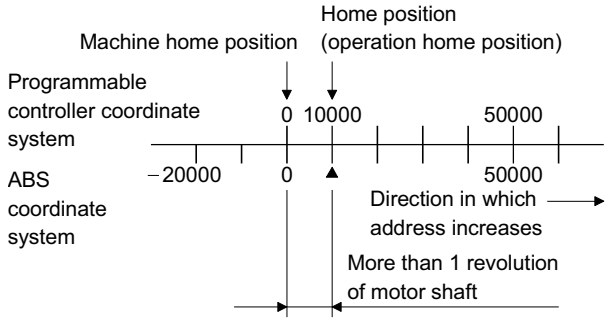
15.8.1 MELSEC-A1S (A1SD71)

(1) Instructions

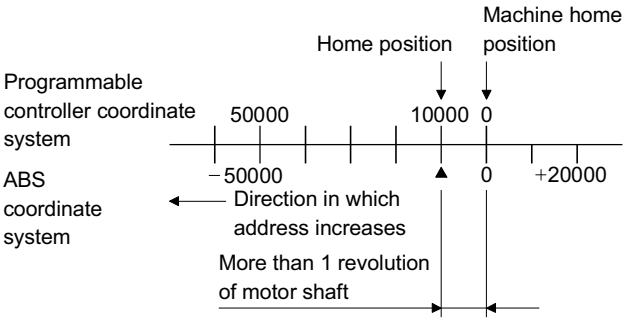
The absolute coordinate system (programmable controller coordinate system) of the A1SD71 (AD71) only covers the range in which the address increases (positive coordinate values) on moving away from the machine home position (the position reached in the home position return operation). Therefore, if the motor enters the range where the coordinate value is negative due to the load torque or a fall on a vertical axis when the power is turned ON/OFF at a point near the machine home position, the system fails to detect the absolute position. To prevent this problem, it is necessary to set the home position (operation home position) for positioning in addition to the machine home position.

(a) The home position should be set in the direction in which the position address of the programmable controller coordinate system increases on moving away from machine home position, as illustrated below. Note that the home position for positioning must be more than one revolution of the servo motor shaft from the machine home position.

If the address of the machine home position is changed to any value other than "0", the home position should be set in the direction in which the position address increases on moving away from the machine home position (machine home position after changing the home position address) and at a point removed from the machine home position by more than one revolution of the motor shaft.

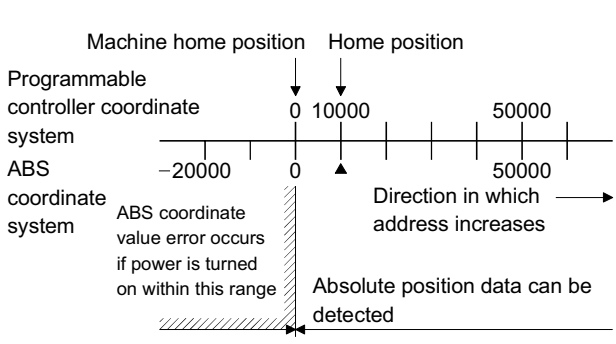


a) If revolution direction parameter (Pr. 14)=0

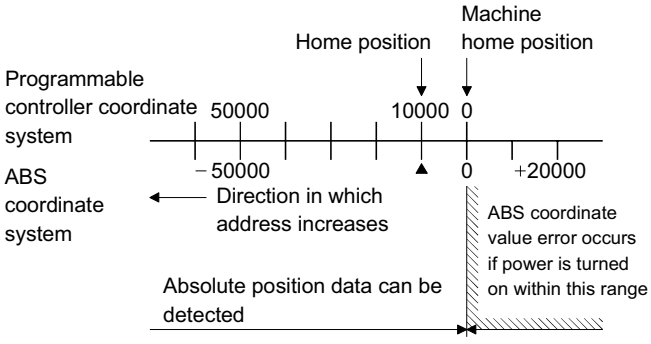


b) If revolution direction parameter (Pr. 14)=1

(b) In the range where the address decreases on moving away from the machine home position, do not turn the power supply to the programmable controller or the servo amplifier, the servo-on pushbutton switch, or the PC-RESET switch, ON/OFF. If any of these operations are attempted, the ABS coordinate error (Y4B) is output since the absolute position cannot be detected.

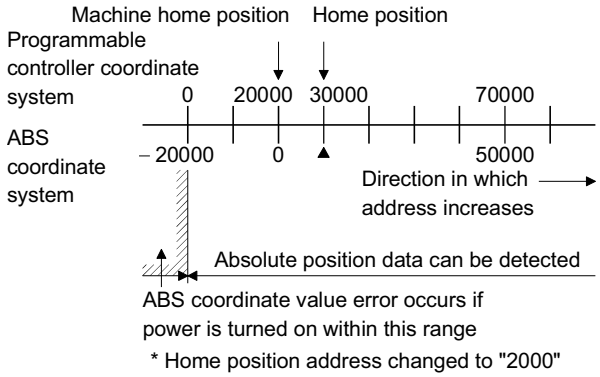


a) If revolution direction parameter (Pr. 14)=0

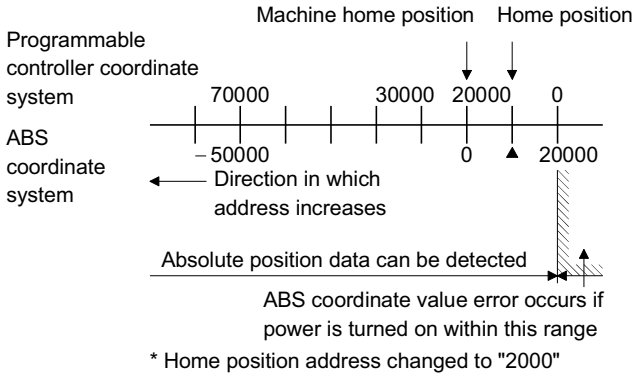


b) If revolution direction parameter (Pr. 14)=1

If the address of the machine home position is changed to any coordinate value other than "0", the programmable controller coordinate system will be as illustrated below.
The power should be turned ON/OFF in the range in which the address increases on moving away from the home position.



a) If revolution direction parameter (Pr. 14) = 0

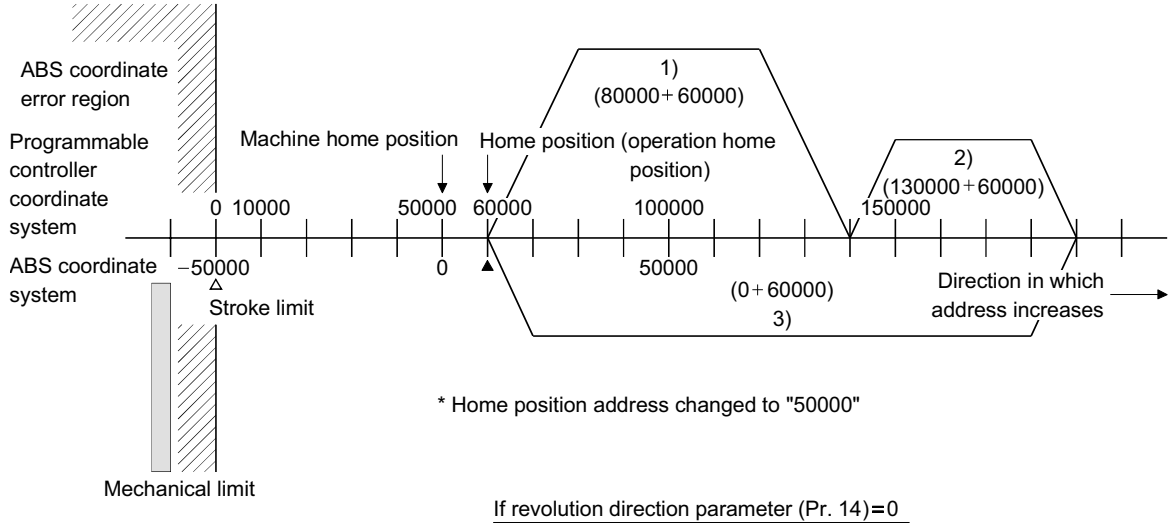


b) If revolution direction parameter (Pr. 14) = 1

(c) In a positioning program, the address of the positioning point should be determined by adding the home position address to the target position address.

Example) After home position return, execute positioning at 1) to 3).

1) Positioning at position address 80000
(PC coordinate 140000)
2) Positioning at position address 130000
(PC coordinate 190000)
3) Positioning at position address 0
(PC coordinate 60000)

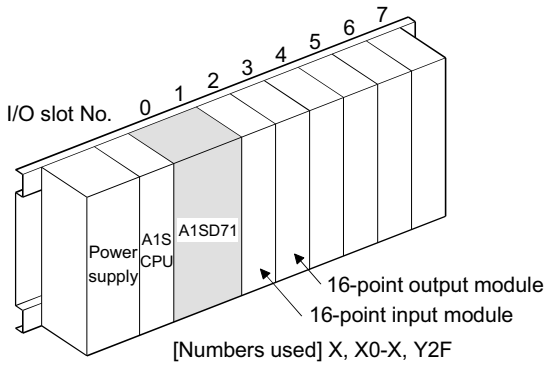


If revolution direction parameter (Pr. 14)=0

(d) Slot arrangement

The sequence programs presented in this section show I/O numbers (X, Y) assuming the arrangement of modules on the main base unit is as illustrated below. A1SD71 is mounted at I/O slots 0 and 1, a 16-point input module at slot 2, and 16-point output module at slot 3. If the actual arrangement of the modules differs from this arrangement, change the X and Y numbers accordingly.

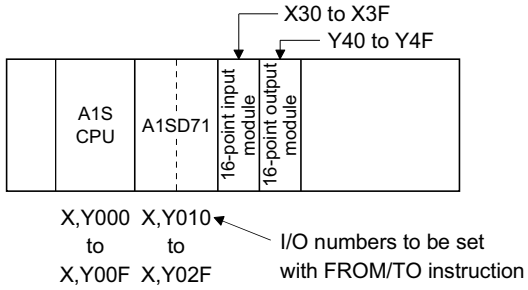
The numbers of the devices (M, D, T, etc.) used in the program can be changed as required.



Example arrangement of modules

(e) Points

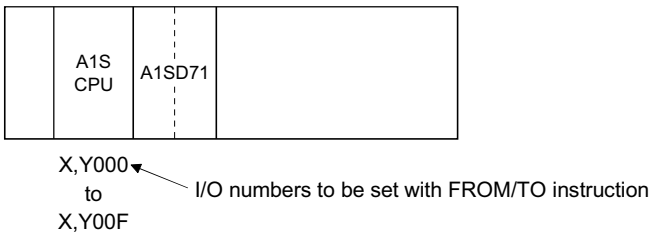
1) The A1SD71 has 48 I/O points and occupies 2 slots. For I/O allocation using the GPP function, follow the instructions given below.
   First slot: Vacant slot 16 points
   Second slot: Special function module 32 points
2) To execute the FROM/TO instruction for the A1SD71, use the head I/O number of the second slot.



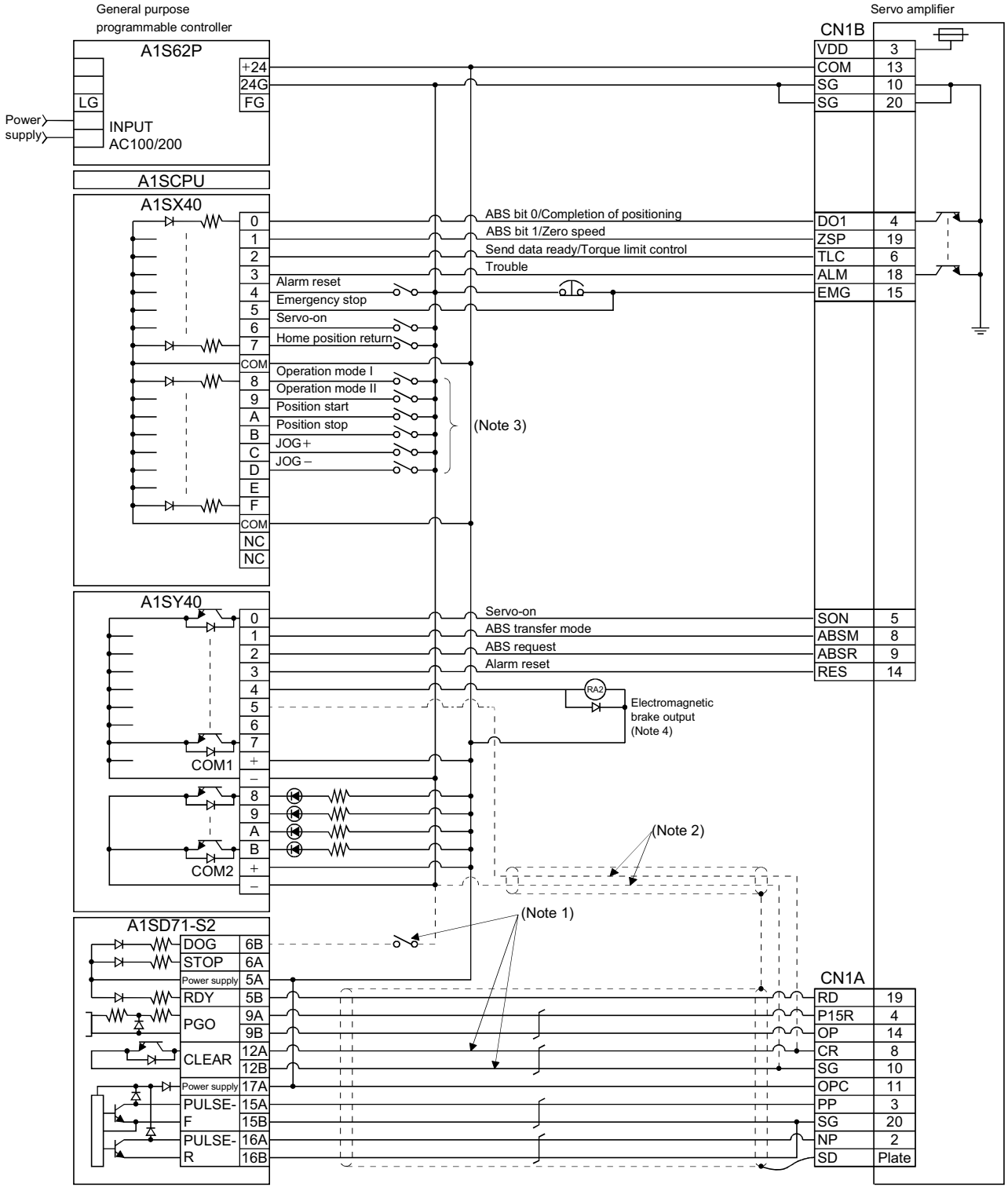
Note: The program example given in (3) in this section is for 1-axis control. Slot allocations are as illustrated to the left. To use the system for 2-axis control, increase the number of I/O points.

Therefore, the I/O number to be set with the FROM/TO instruction is head I/O number allocated to the A1SD71 + 010H.

3) By setting "0 point of vacant slot" for the first slot of the A1SD71 in the "I/O allocation" of the GPP function, the 16 points in the first slot can be saved.
   In this case, the I/O number to be set with the FROM/TO instruction is the same number as the head I/O number allocated to the A1SD71.



(2) Connection diagram



Note: 1. To be connected for dog type home position setting. The connection in Note 2 is not required.
2. To be connected for data set type home position setting. The connection in Note 1 is not required.
3. This circuit is for reference only.
4. The electromagnetic brake output should be controlled by connecting the programmable controller output to a relay.

(3) Sequence program example

(a) Conditions

This sample program is an ABS sequence program example for a single axis (X axis).

To transmit the ABS data using the OFF-to-ON change of the servo-on signal as the trigger.

1) When the servo-ON signal and the GND of the power supply are shorted, the ABS data is transmitted when the power to the servo amplifier power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.
2) If a check sum discrepancy is detected in the transmitted data, ABS data transmission is retried up to three times. If the check sum discrepancy is still detected after retrying, the ABS check sum error is generated (Y4A ON).
3) The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y4A ON).
   ON period of ABS transfer mode (Y41)
   ON period of ABS request (Y42)
   OFF period of ready to send ABS data (X32).
4) If the relationship between the polarity (±) of the received ABS data and the setting value for parameter No. 14 (rotating direction) of A1SD71 (AD71) involves negative coordinate values, which cannot be handled by the A1SD71 (AD71), the ABS coordinate error is generated (Y4B ON).

(b) Device list

X input contact		Y output contact	
X30	ABS bit 0 / completion of positioning	Y40	Servo-on
X31	ABS bit 1 / zero speed	Y41	ABS transfer mode
X32	Send ABS data ready / torque limit control	Y42	ABS request
X33	Servo alarm	Y43	Alarm reset
X34	Error reset	X44 (Note 2)	Electromagnetic brake output
X35	Servo emergency stop	Y45 (Note 1)	Clear
X36	Servo-on	Y48	Servo alarm
X37	Home position return start	Y49	ABS communication error
X38	Operation mode I	Y4A	ABS check sum error
X39	Operation mode II	Y4B	ABS coordinate error
D register		M contact	
D0	ABS data transmission counter	M0	ABS data transmission start
D1	Check sum transmission counter	M1	Sum check completion
D2	Check sum addition counter	M2	Sum check discrepancy
D3	ABS data: Lower 16 bits	M3	ABS data ready
D4	ABS data: Upper 16 bits	M4	Transmission data read enabled
D5	ABS data 2-bit receiving buffer	M5	Check sum 2 bits read completion
D6	Check data in case of check sum error	M6	ABS 2 bits read completion
D7	Retry frequency	M7	ABS 2 bits request
D8	Forward rotation direction	M8	Servo-on request
D9	Home position address: Lower 16 bits	M9	Servo alarm
D10	Home position address: Upper 16 bits	M10	ABS data transmission retry start pulse
D100	Received shift data: Lower 16 bits	M11	Retry flag setting
D101	Received shift data: Upper 16 bits	M12	Retry flag reset
T timer		M13	PLS processing command
T0	ABS transfer mode timer	M20 (Note 1)	Clear signal ON timer request
T1	ABS request response timer	M21 (Note 2)	Data set type home position return request
T2	Retry wait timer	C counter	
T3	Ready to send response timer	C0	ABS data receive frequency counter
T10 (Note 1)	Clear signal ON timer	C1	Check sum receive frequency counter
T200	Transmitted data read 10ms delay timer	C2	Retry counter

Note 1: Necessary when data set type home position return is executed.
2: Necessary in the event of electromagnetic brake output.

(c) ABS data transfer program for X axis

This sequence program example assumes the following conditions:

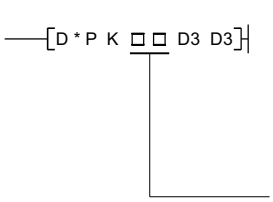
・Parameters of the A1SD71-S2 (AD71) positioning module

1) Unit setting : 3 = pulse (PLS)

2) Travel per pulse : 1 = 1 pulse

To select the unit other than the pulse, conversion into the unit of the feed command value per pulse is required. Hence, add the following program to the area marked Note in the sequence program.

<Additional program>



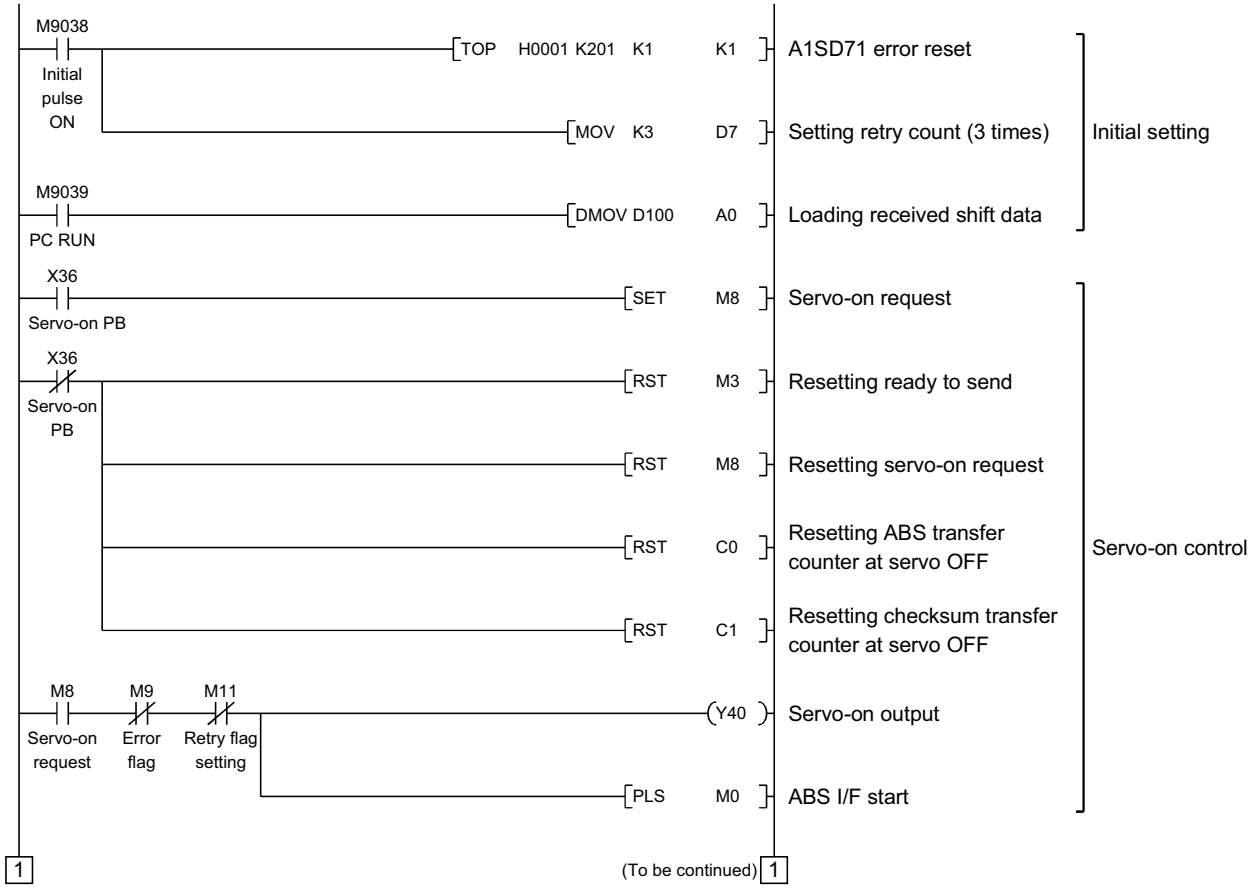
Item	mm			inch			degree			pulse
Unit setting	0			1			2			3
Travel per pulse	0.1 to	1.0 to	10.0	0.00001 to	0.0001 to	0.001 to	0.00001 to	0.0001 to	0.001 to	
Unit of travel	μm/PLS			inch/PLS			degree/PLS			PLS
Constant K for conversion into unit of travel	1 to	10 to	100	1 to	10 to	100	1 to	10 to	100	None

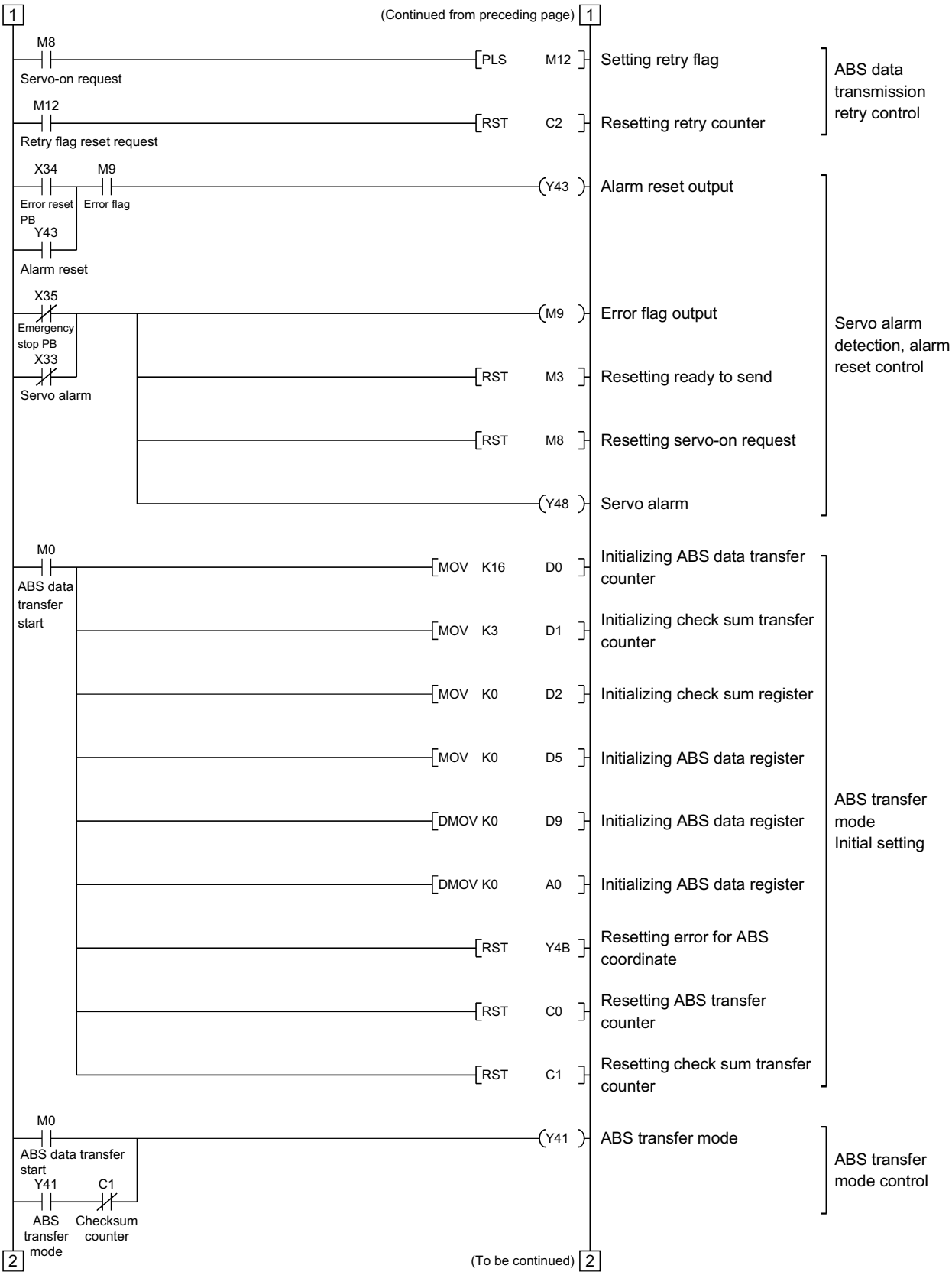
Reference

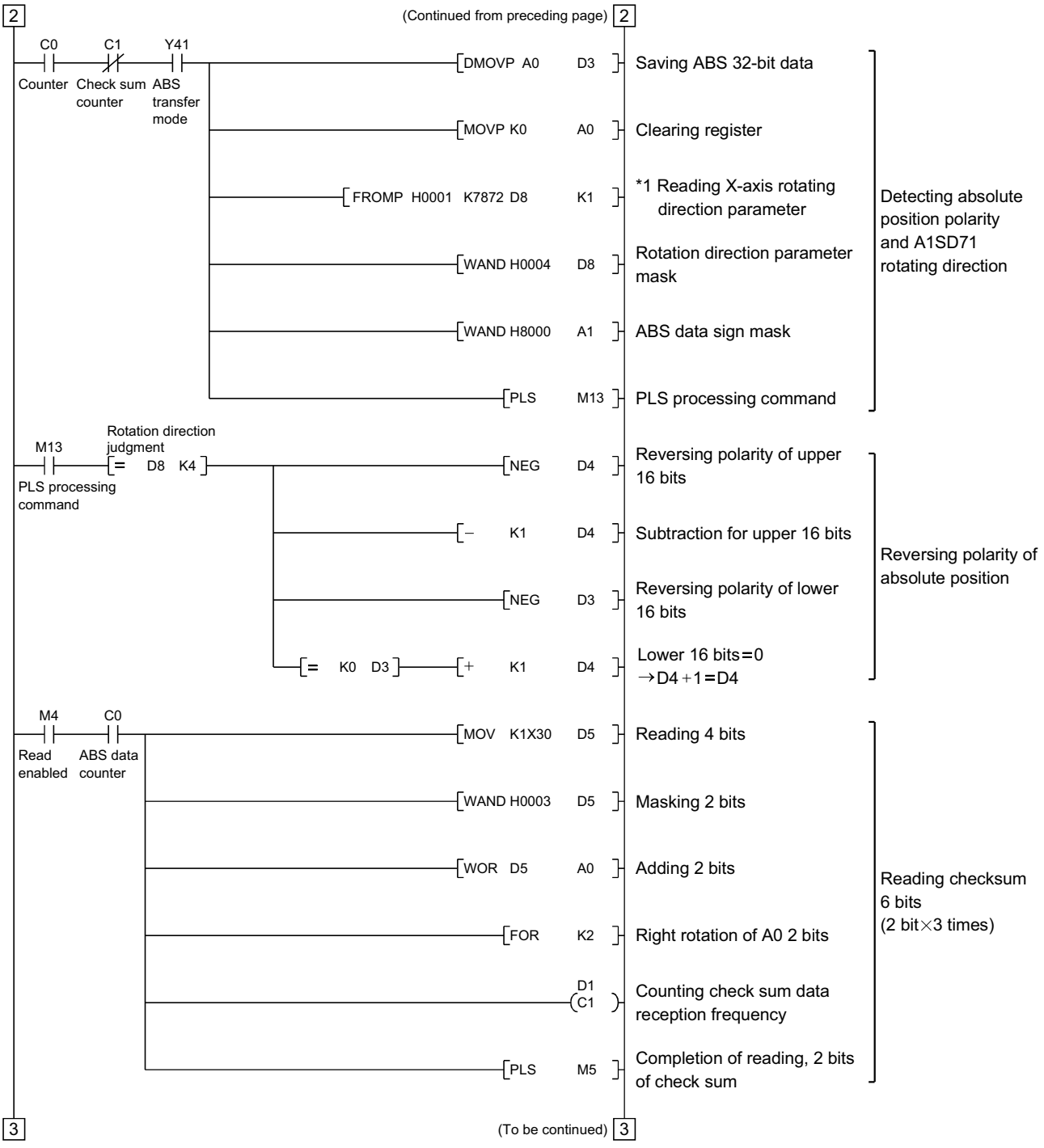
・For 1μm/PLS, set constant K to 10

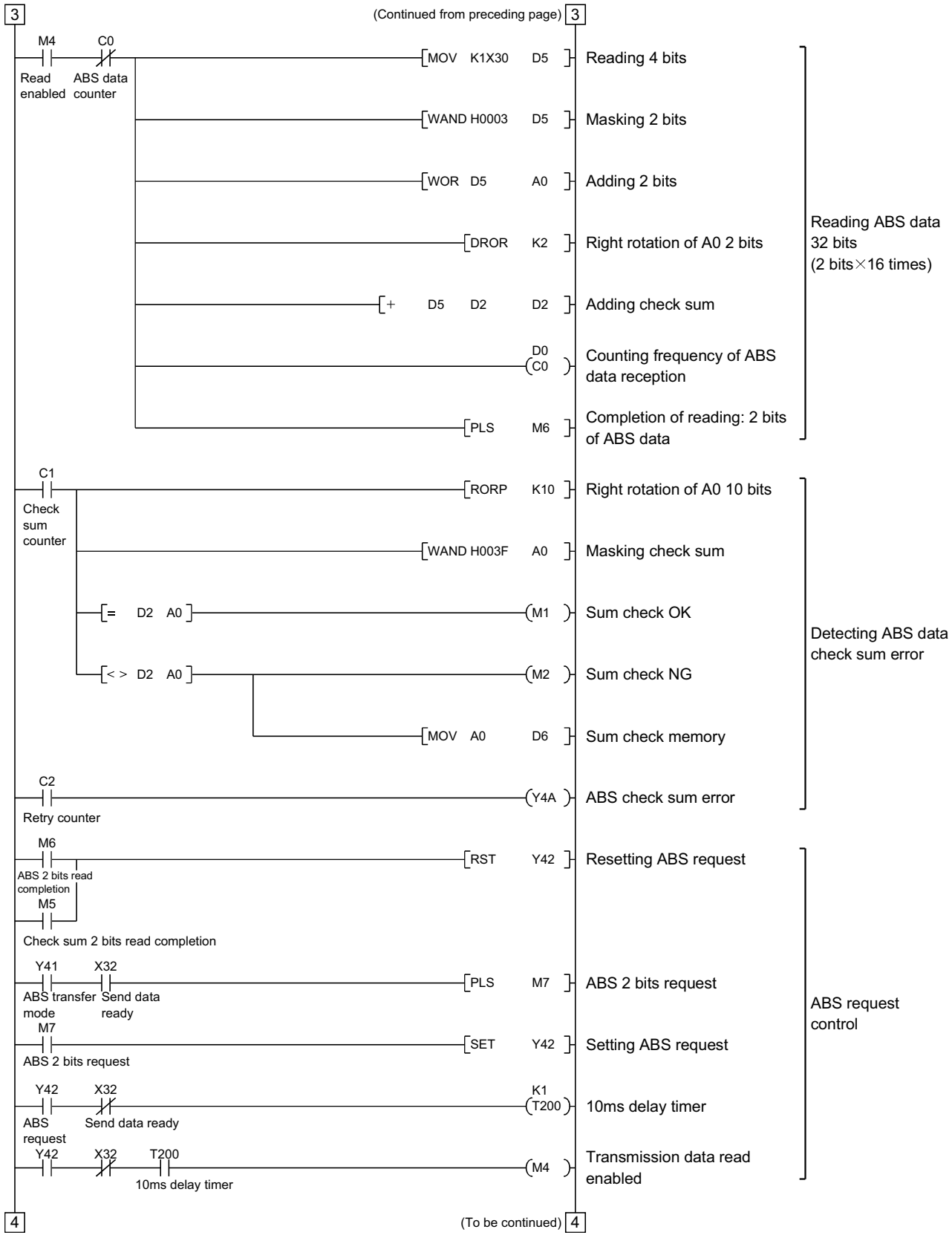
・For 5μm/PLS, set constant K to 50

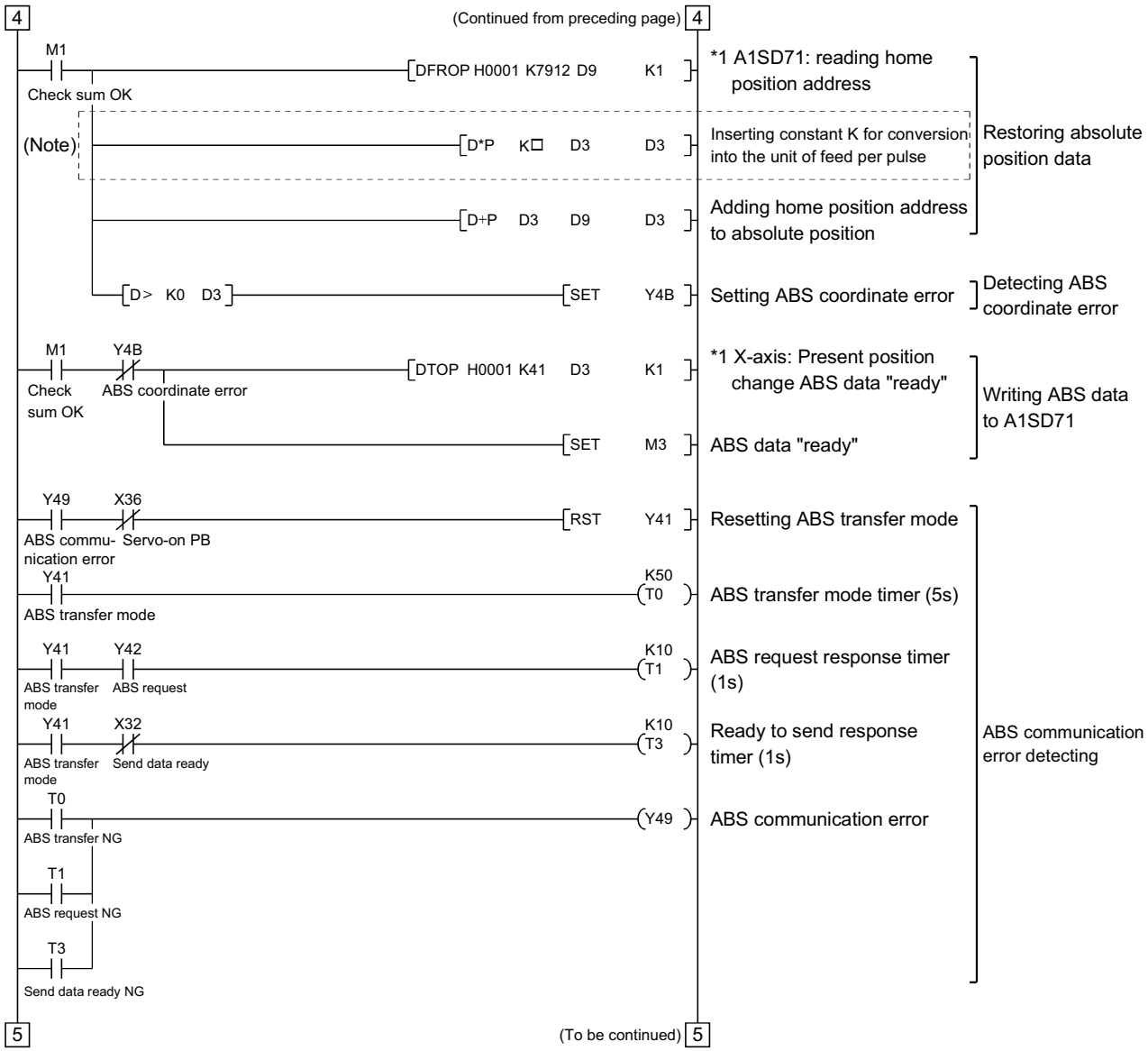
・When the unit setting is pulse, the additional program is not required.



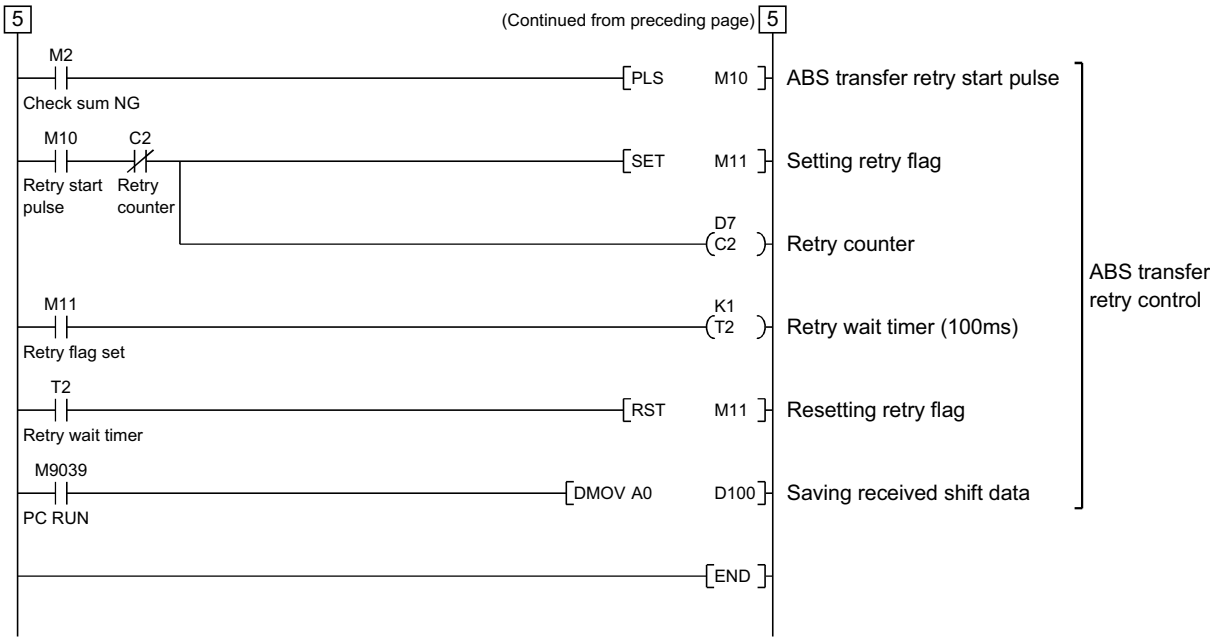

1
(Continued from preceding page)
1
M8
Servo-on request
PLS M12
Setting retry flag
M12
Retry flag reset request
RST C2
Resetting retry counter
ABS data transmission retry control
X34
Error reset PB
M9
Error flag
Y43
Alarm reset
Y43
Alarm reset output
X35
Emergency stop PB
X33
Servo alarm
M9
Error flag output
RST M3
Resetting ready to send
RST M8
Resetting servo-on request
Y48
Servo alarm
Servo alarm detection, alarm reset control
M0
ABS data transfer start
MOV K16 D0
Initializing ABS data transfer counter
MOV K3 D1
Initializing check sum transfer counter
MOV K0 D2
Initializing check sum register
MOV K0 D5
Initializing ABS data register
DMOV K0 D9
Initializing ABS data register
DMOV K0 A0
Initializing ABS data register
RST Y4B
Resetting error for ABS coordinate
RST C0
Resetting ABS transfer counter
RST C1
Resetting check sum transfer counter
ABS transfer mode Initial setting
M0
ABS data transfer start
Y41
ABS transfer mode
C1
Checksum counter
Y41
ABS transfer mode
ABS transfer mode control
2
(To be continued)
2


2
(Continued from preceding page)
2
C0
C1
Y41
Counter
Check sum counter
ABS transfer mode
DMOVP A0 D3
Saving ABS 32-bit data
MOVP K0 A0
Clearing register
FROMP H0001 K7872 D8 K1
*1 Reading X-axis rotating direction parameter
WAND H0004 D8
Rotation direction parameter mask
WAND H8000 A1
ABS data sign mask
PLS M13
PLS processing command
Detecting absolute position polarity and A1SD71 rotating direction
M13
Rotation direction judgment
= D8 K4
PLS processing command
NEG D4
Reversing polarity of upper 16 bits
– K1 D4
Subtraction for upper 16 bits
NEG D3
Reversing polarity of lower 16 bits
= K0 D3
+ K1 D4
Lower 16 bits=0 →D4+1=D4
Reversing polarity of absolute position
M4
C0
Read enabled
ABS data counter
MOV K1X30 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
FOR K2
Right rotation of A0 2 bits
D1
C1
Counting check sum data reception frequency
PLS M5
Completion of reading, 2 bits of check sum
Reading checksum 6 bits
(2 bit×3 times)
3
(To be continued)
3


3
(Continued from preceding page)
3
M4
C0
Read enabled
ABS data counter
MOV K1X30 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
DROR K2
Right rotation of A0 2 bits
+ D5 D2 D2
Adding check sum
D0
C0
Counting frequency of ABS data reception
PLS M6
Completion of reading: 2 bits of ABS data
Reading ABS data 32 bits (2 bits×16 times)
C1
Check sum counter
RORP K10
Right rotation of A0 10 bits
WAND H003F A0
Masking check sum
= D2 A0
M1
Sum check OK
< > D2 A0
M2
Sum check NG
MOV A0 D6
Sum check memory
C2
Retry counter
Y4A
ABS check sum error
Detecting ABS data check sum error
M6
ABS 2 bits read completion
M5
Check sum 2 bits read completion
RST Y42
Resetting ABS request
Y41
ABS transfer mode
X32
Send data ready
PLS M7
ABS 2 bits request
M7
ABS 2 bits request
SET Y42
Setting ABS request
Y42
ABS request
X32
Send data ready
K1
T200
10ms delay timer
Y42
X32
T200
10ms delay timer
M4
Transmission data read enabled
ABS request control
4
(To be continued)
4



Note: When the unit setting parameter value of the AD71 positioning module is changed from "3" (pulse) to "0" (mm), the unit is×0.1μm for the input value. To change the unit to×1μm, and this program to multiple the feed value by 10.



POINT

- When absolute position data is received at power ON, for example, if a negative coordinate position which cannot be handled by the A1SD71 is detected, the ABS coordinate error (Y4B ON) is generated. If this error is generated, move the axis into the positive coordinate zone in JOG operation. Then, turn OFF the servo-on pushbutton switch and turn it ON again.

(d) X-axis control program

This precludes execution of the X-axis start program while M3 (ready to send the ABS data) is OFF.

(e) Dog type home position return

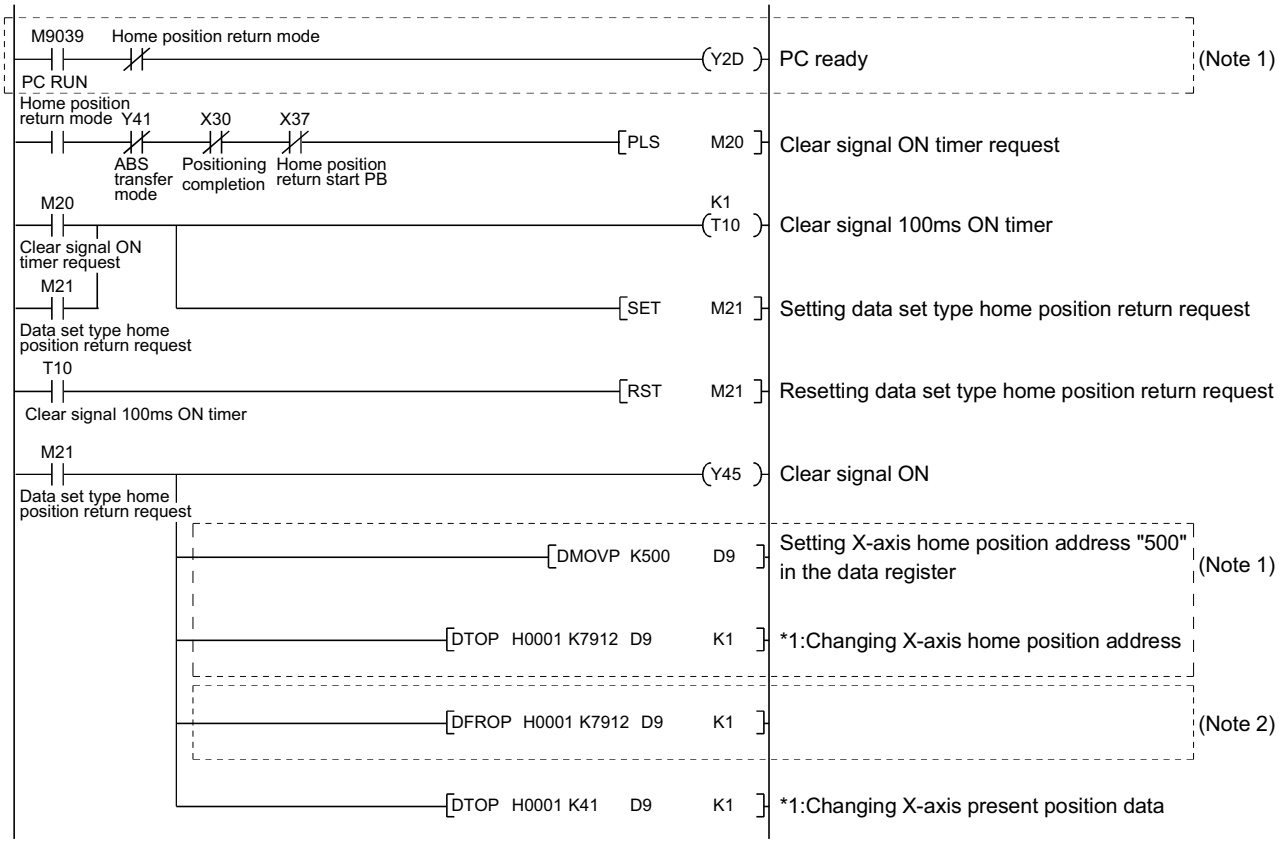
For an example of a program for the dog type home position return operation, refer to the home position return program presented in the User's Manual for A1SD71.

(f) Data set type home position return

After jogging the machine to the position where the home position (e.g.500) is to be set, choose the home position return mode set the home position with the home position return start (PB ON).

After switching power on, rotate the servo motor more than 1 revolution before starting home position return.

Do not turn ON the clear signal (Y45) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



Note 1: If data of the home position address parameter is not written by using an A6GPP programming tol, etc. before starting a program for data set type home position return, the circuits indicated by Note 1 are necessary and the circuit indicated by Note 2 is not necessary.

2: Contrary to Note 1 above, if the home position address is written in the home position address parameter. the circuit indicated by Note 3 is necessary and the circuits indicated by Note 1 are not necerssary.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

Set "1 □ 1 □"in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.

(h) Positioning completion

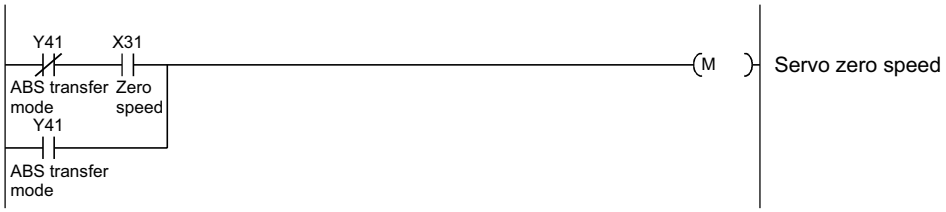
To create the status information for servo positioning completion.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

(i) Zero speed

To create the status information for servo zero speed

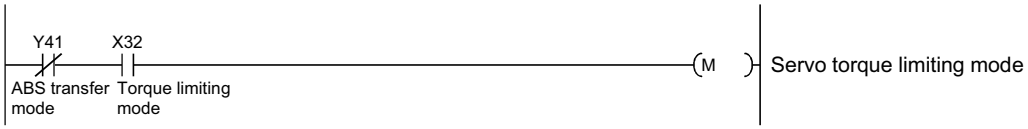
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.



(j) Torque limiting

To create the status information for the servo torque limiting mode

During ABS data transfer (for several seconds after the servo-on signal is turned on), the torque limiting must be off.



(4) Sequence program - 2-axis control

The following program is a reference example for creation of an ABS sequence program for the second axis (Y axis) using a single A1SD71 module. Create a program for the third axis in a similar manner.

(a) Y-axis program

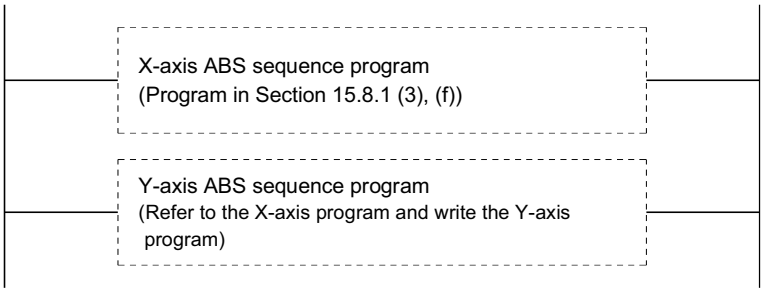
Refer to the X-axis ABS sequence program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts, T timers and C counters of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD71 differ between the X and Y axes. The instructions marked *1 in the program of Section 15.8.1 (3), (c) should be changed as indicated below for use with the Y axis:

```
[FROMP  H0001  K7872  D8  K1]   →   [FROMP  H0001  K7892  D8  K1]
[DFROP  H0001  K7912  D9  K1]   →   [DFROP  H0001  K7922  D9  K1]
[DTOP   H0001  K41    D3  K1]   →   [DTOP   H0001  K341   D3  K1]
```

[Program configuration]



(b) Data set type home position return

Arrange the data set type home position return programs given in Section 15.8.1 (3), (f) in series to control two axes.

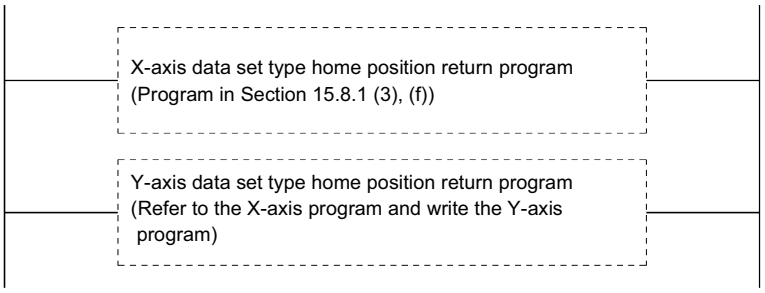
Refer to the X-axis data set type home position return program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts and T timers of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of Section 15.8.1 (3), (f) should be changed as indicated below for use with the Y axis:

```
[DTOP   H0001  K7912  D9  K1]   →   [DTOP   H0001  K7922  D9  K1]
[DTOP   H0001  K41    D9  K1]   →   [DTOP   H0001  K341   D9  K1]
```

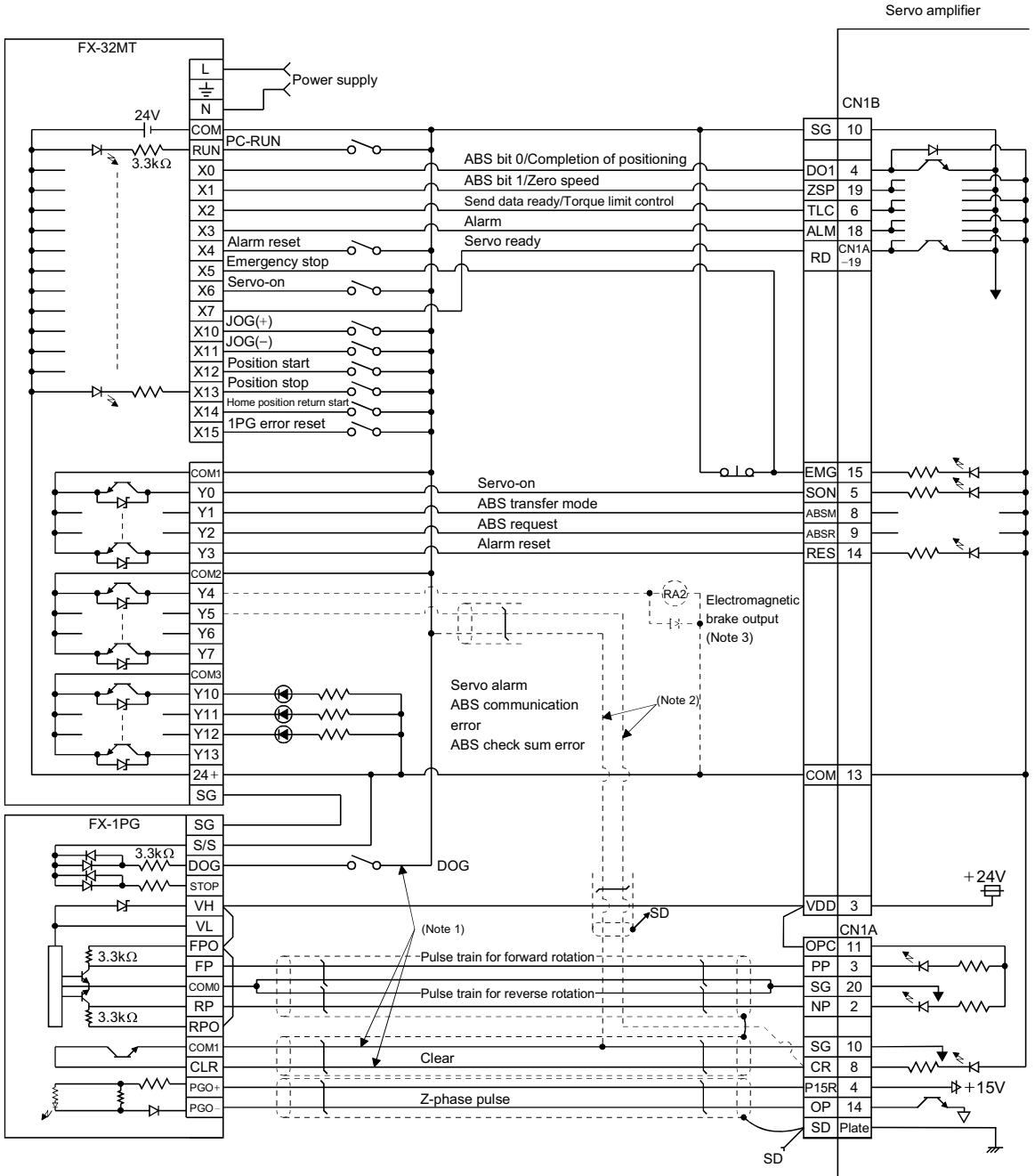
[Program configuration]



15.8.2 MELSEC FX(2N)-32MT (FX(2N)-1PG)

(1) Connection diagram

(a) FX-32MT (FX-1PG)

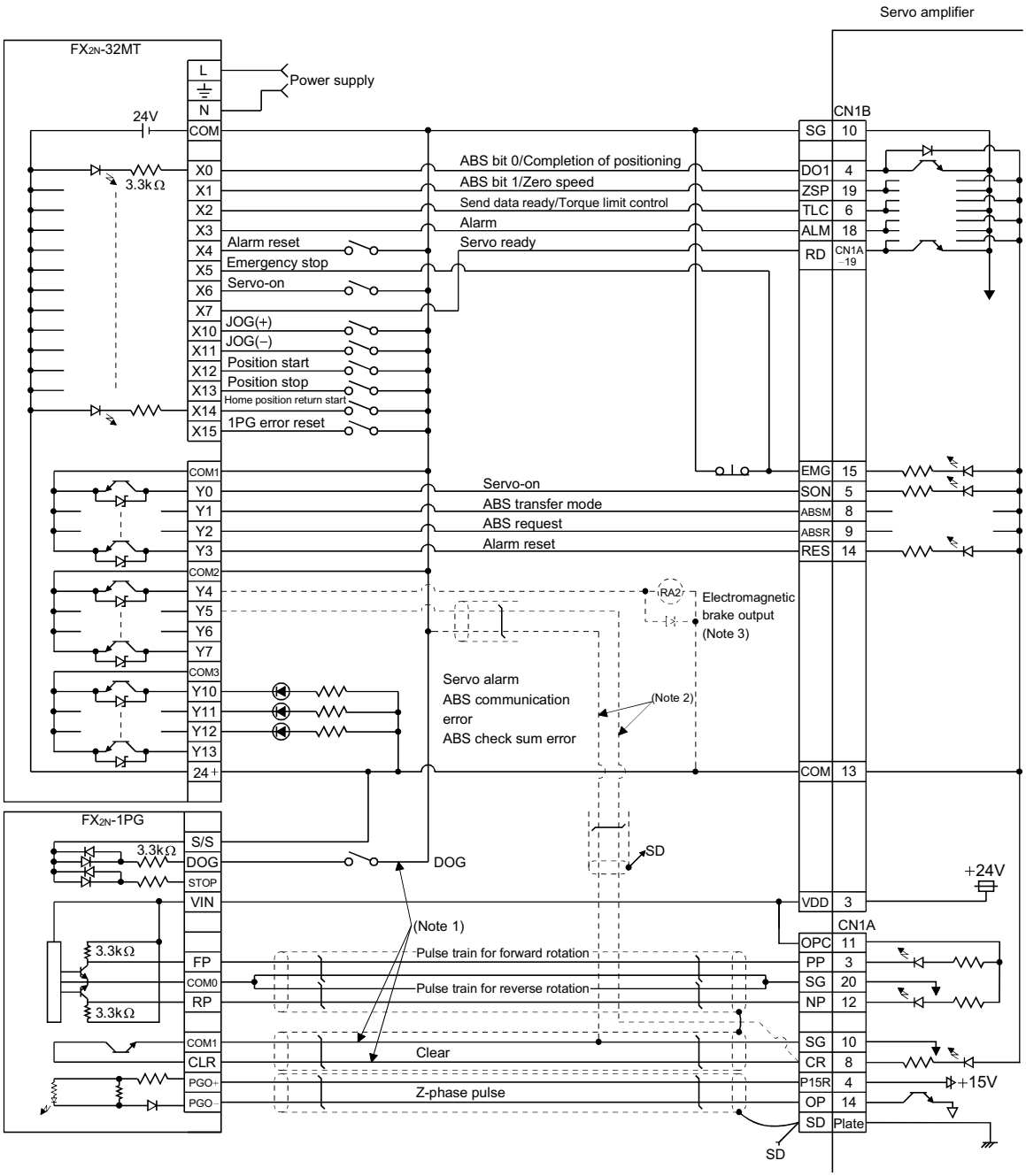


Note 1: To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).

2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

3: The electromagnetic brake interlock signal should be controlled by connecting the programmable controller output to a relay.

(b) FX2N-32MT (FX2N-1PG)



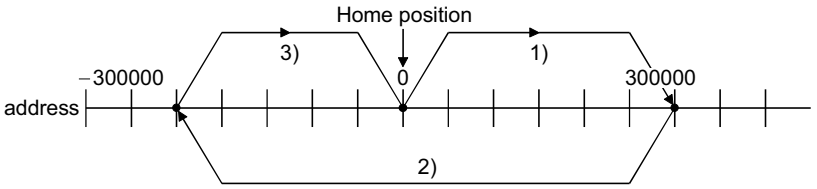
Note 1: To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).
2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).
3: The electromagnetic brake interlock signal should be controlled by connecting the programmable controller output to a relay.

(2) Sequence program example

(a) Conditions

1) Operation pattern

ABS data transfer is made as soon as the servo-on pushbutton is turned on. After that, positioning operation is performed as shown below:



After the completion of ABS data transmission, JOG operation is possible using the JOG+ or JOG− pushbutton switch.

After the completion of ABS data transmission, dog type home position return is possible using the home position return pushbutton switch.

2) Buffer memory assignment

For BFM#26 and later, refer to the FX2(N)-1PG User's Manual.

BMF No.		Name and symbol		Set value	Remark
Upper 16 bits	Lower 16 bits				
-	#0	Pulse rate	A	2000	
#2	#1	Feed rate	B	1000	
-	#3	Parameter		H0000	Command unit: Pulses
#5	#4	Max. speed	Vmax	100000PPS	
-	#6	Bias speed	Vbia	0PPS	
#8	#7	JOG operation	Vjog	10000PPS	
#10	#9	Home position return speed (high speed)	VRT	50000PPS	
-	#11	Home position return speed (creep)	VCL	1000PPS	
-	#12	Home position return zero-point signal count	N	2 pulses	Initial value: 10
#14	#13	Home position address	HP	0	
-	#15	Acceleration/deceleration time	Ta	200ms	Initial value: 100
-	#16	Not usable			
#18	#17	Target address (I)	P(I)	0	
#20	#19	Operation speed (I)	V(I)	100000	Initial value: 10
#22	#21	Target address (II)	P(II)	0	
#24	#23	Operation speed (II)	V(II)	10	
-	#25	Operation command		H0000	

3) Instructions

When the servo-on pushbutton switch and the GND of the power supply are shorted, the ABS data is transmitted when the servo amplifier power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.

If check sum discrepancy is detected in the transmitted data, the ABS data transmission is retried up to three times. If the check sum discrepancy is still detected after retrying, the ABS check sum error is generated (Y12 ON).

The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y11 ON).

ON period of ABS transfer mode (Y1)

ON period of ABS request (Y2)

OFF period of ready to send the ABS data (X2).

(b) Device list

X input contact	
X0	ABS bit 0 / completion of positioning
X1	ABS bit 1 / zero speed
X2	Send ABS data ready/ torque limit control
X3	Servo alarm
X4	Alarm reset PB
X5	Servo emergency stop
X6	Servo-on PB
X7	Servo ready
X10	JOG (+) PB
X11	JOG (–) PB
X12	Position start PB
X13	Position stop PB
X14	Home position return start PB
X15	1PG error reset

Y output contact	
Y0	Servo-on
Y1	ABS transfer mode
Y2	ABS request
Y3	Alarm reset
Y4 (Note 2)	Electromagnetic brake output
Y5 (Note 1)	Clear
Y10	Servo alarm
Y11	ABS communication error
Y12	ABS check sum error

D register	
D0	ABS data: Lower 16 bits
D1	ABS data: Upper 16 bits
D2	Check sum addition counter
D3	Check data in case of check sum error
D4	Transmission retry count in check sum discrepancy
D24	Home position address: Lower 16 bits
D25	Home position address: Upper 16 bits
D106	1PG present position address: Lower 16 bits
D107	1PG present position address: Upper 16 bits

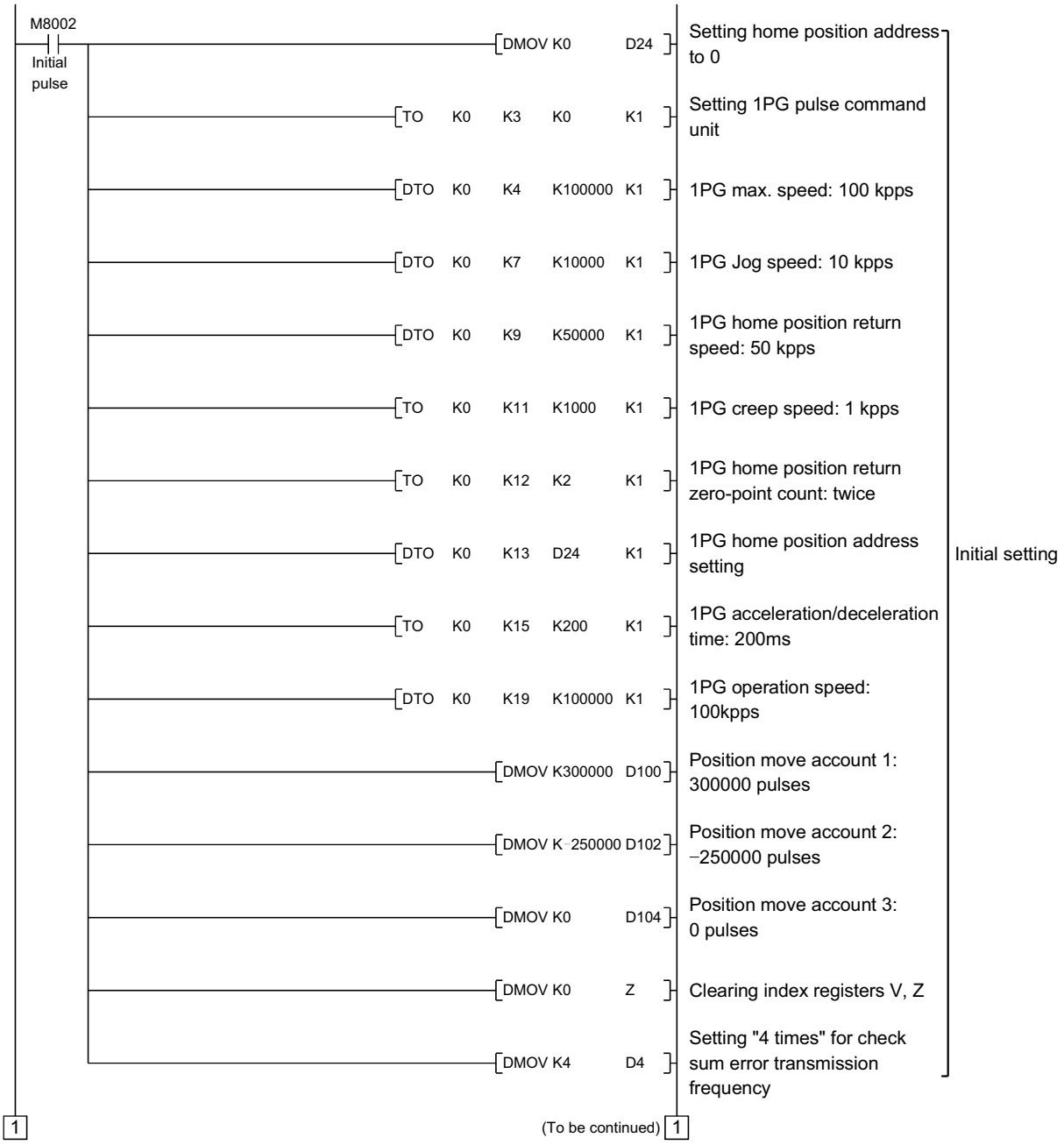
T timer	
T200	Retry wait timer
T201	ABS transfer mode timer
T202	ABS request response timer
T203	Ready to send response timer
T204	ABS data waiting timer
T210 (Note 1)	Clear signal ON timer

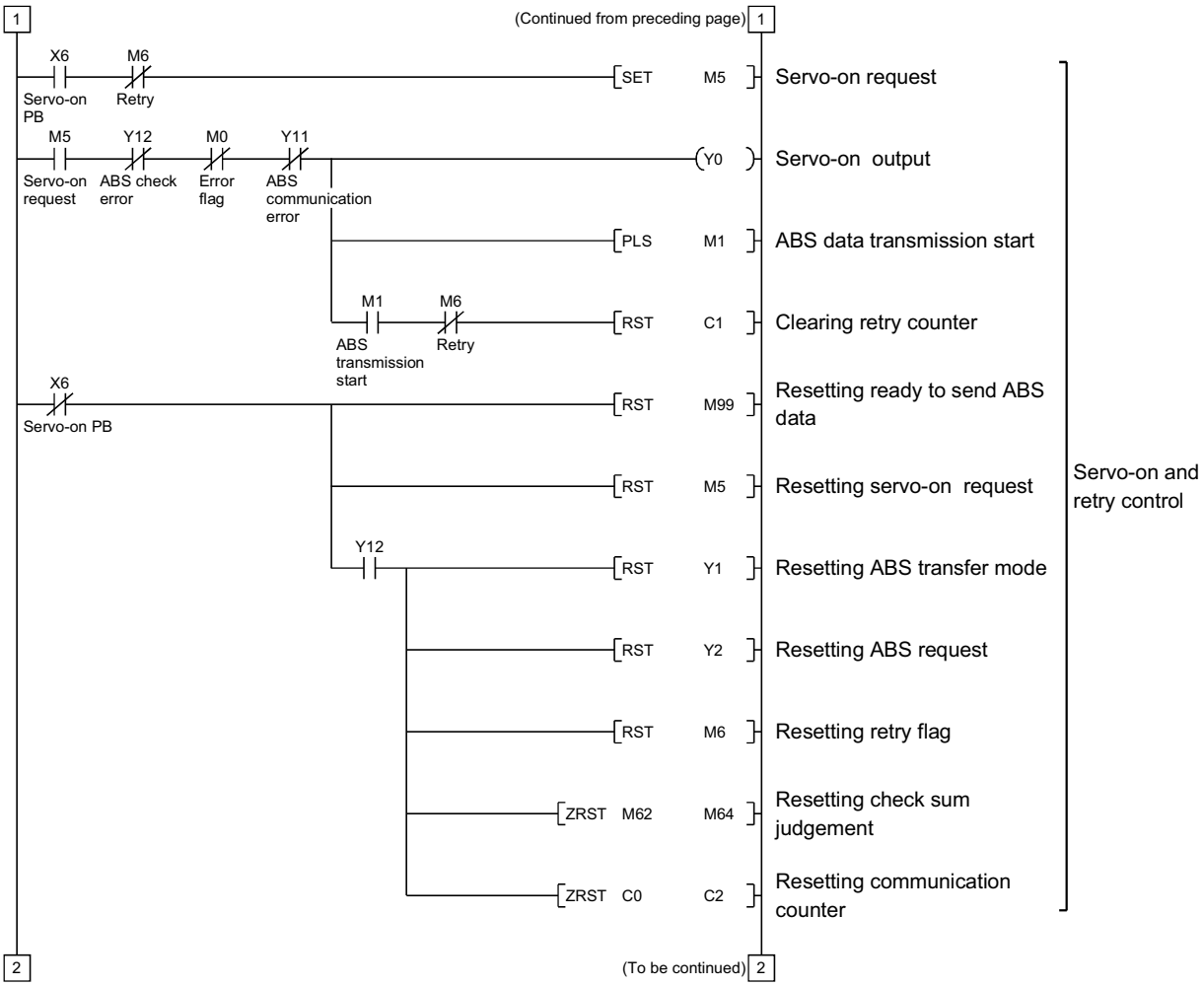
M contact	
M0	Error flag
M1	ABS data transmission start
M2	Retry command
M3	ABS data read
M4	Spare
M5	Servo-on request
M6	Retry flag
M10	ABS data 2 bit receiving buffer
M11	
M12	
M13	
M20 ↓ M51	ABS data 32 bit buffer
M52 ↓ M57	Check sum 6 bit buffer
M58	For checksum comparison
M59	
M62	Sum check discrepancy (greater) >
M63	Sum check discrepancy =
M64	Sum check discrepancy (less) >
M70 (Note 1)	Clear signal ON timer request
M71 (Note 1)	Data set type home position return request
M99	ABS data ready

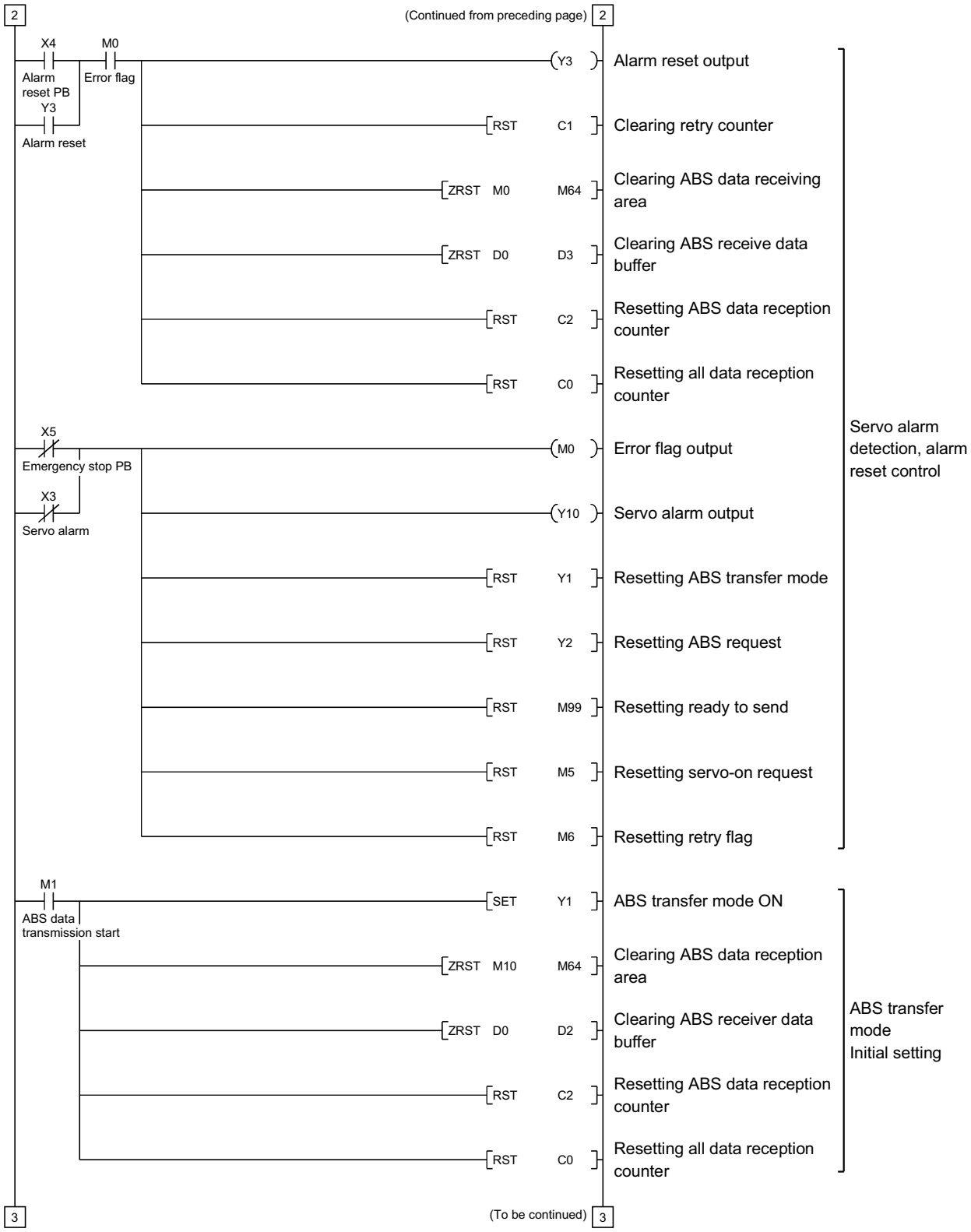
C counter	
C0	All data reception frequency counter (19 times)
C1	Check sum reception frequency counter
C2	ABS data reception frequency counter (16 times)

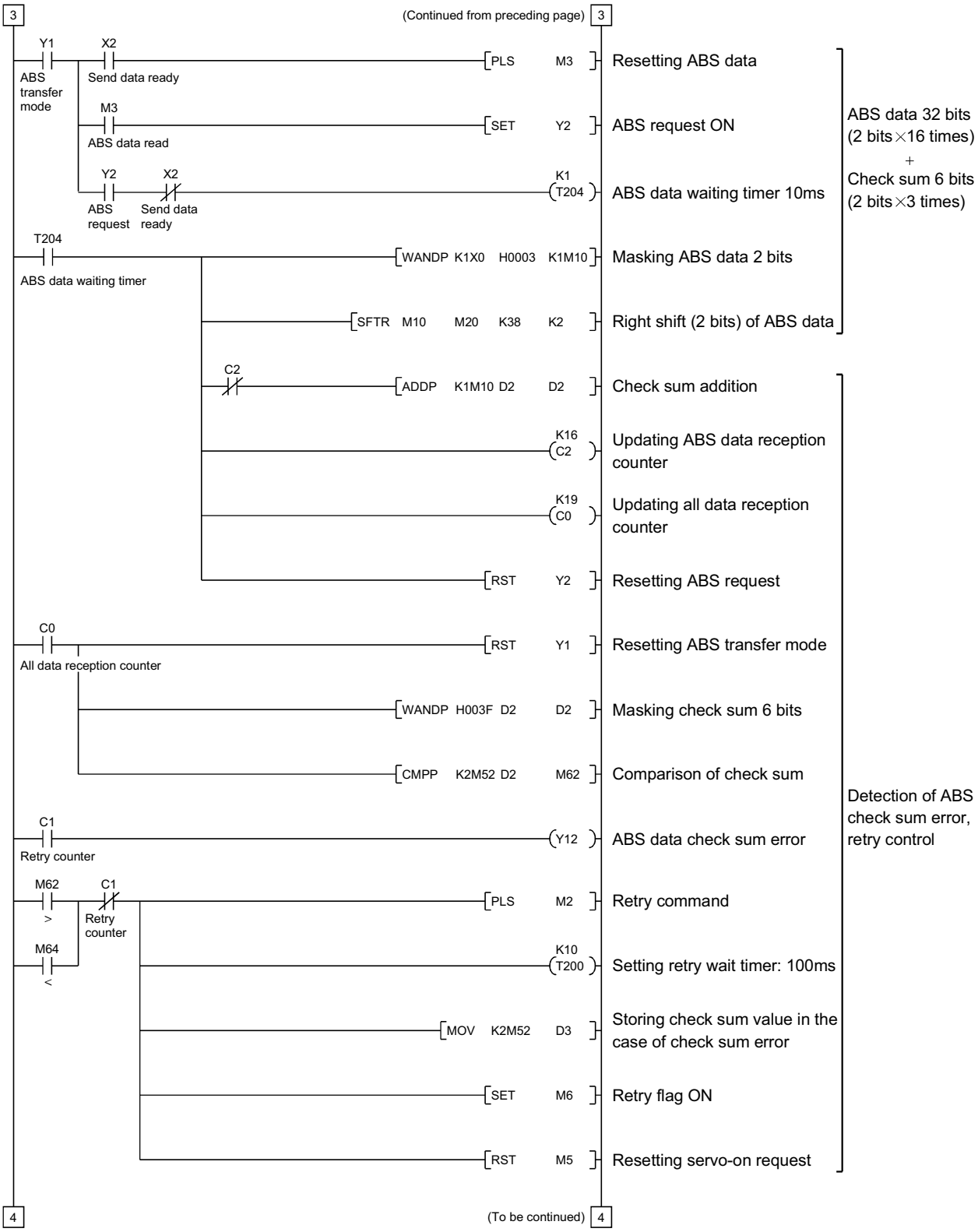
Note 1: Necessary when data set type home position return is executed.
2: Necessary in the event of electromagnetic brake output.

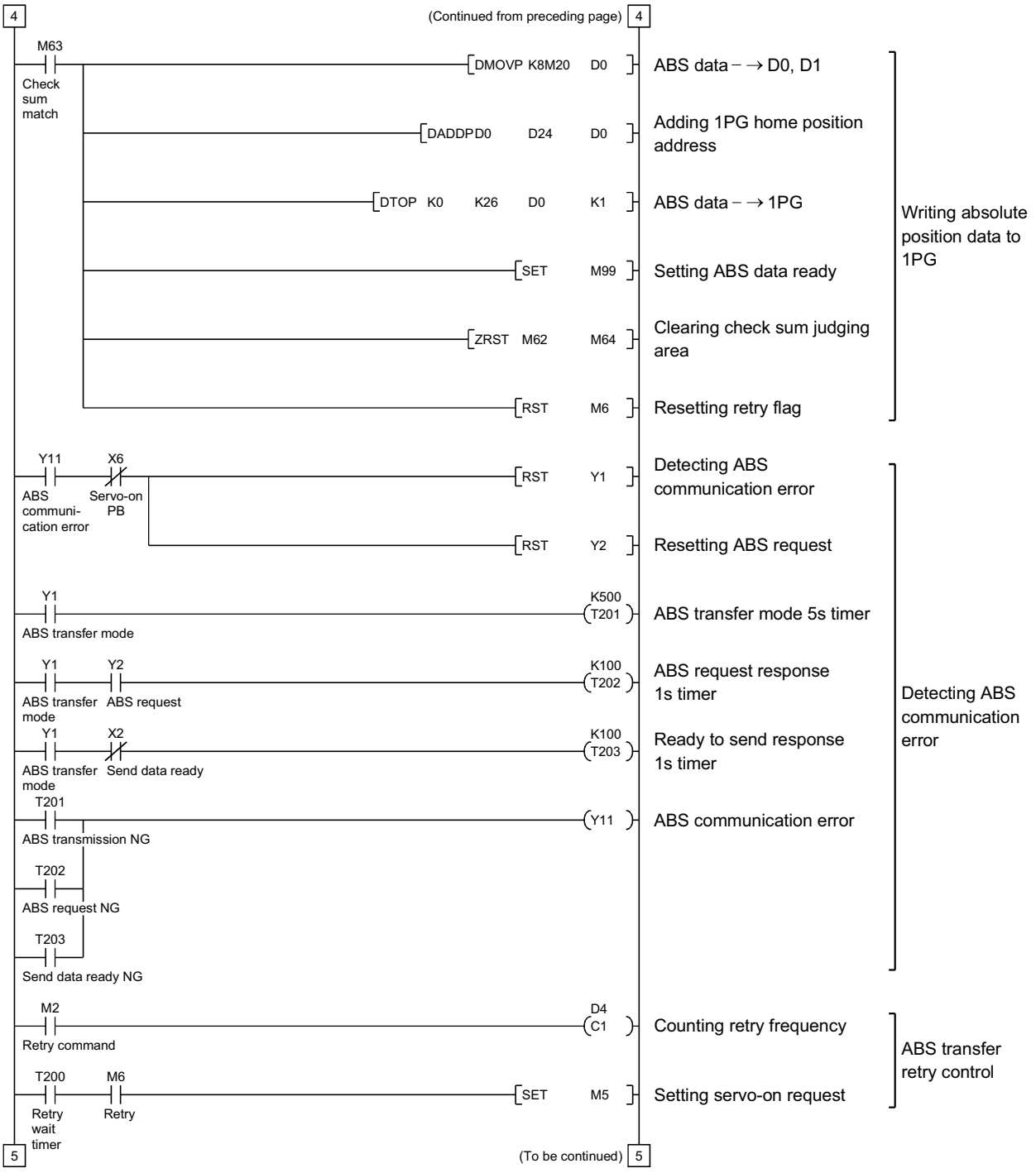
(c) ABS data transfer program for X-axis

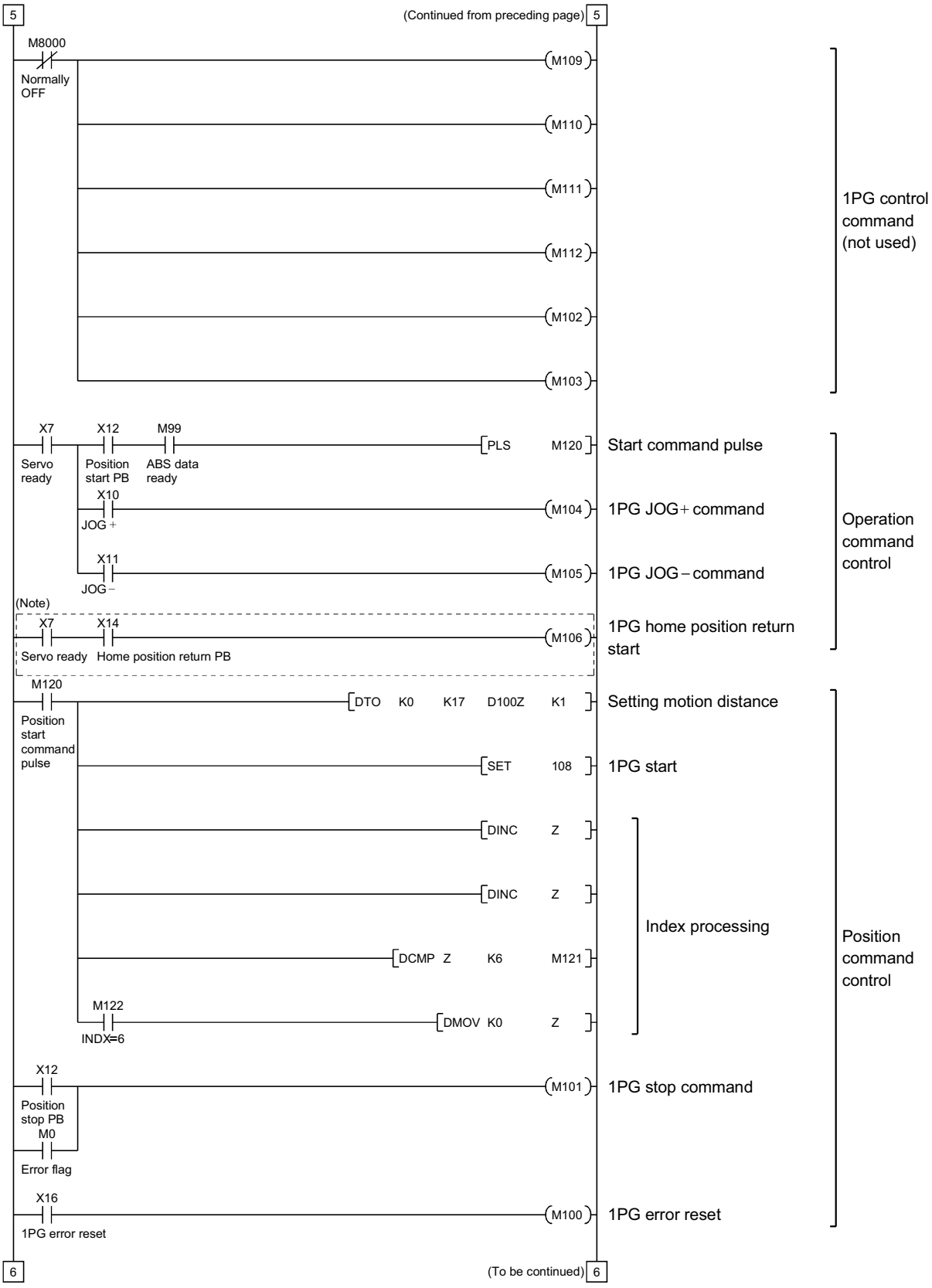



1
(Continued from preceding page)
1
X6
Servo-on PB
M6
Retry
SET M5
Servo-on request
M5
Servo-on request
Y12
ABS check error
M0
Error flag
Y11
ABS communication error
Y0
Servo-on output
PLS M1
ABS data transmission start
M1
ABS transmission start
M6
Retry
RST C1
Clearing retry counter
X6
Servo-on PB
RST M99
Resetting ready to send ABS data
RST M5
Resetting servo-on request
Y12
RST Y1
Resetting ABS transfer mode
RST Y2
Resetting ABS request
RST M6
Resetting retry flag
ZRST M62 M64
Resetting check sum judgement
ZRST C0 C2
Resetting communication counter
Servo-on and retry control
2
(To be continued)
2

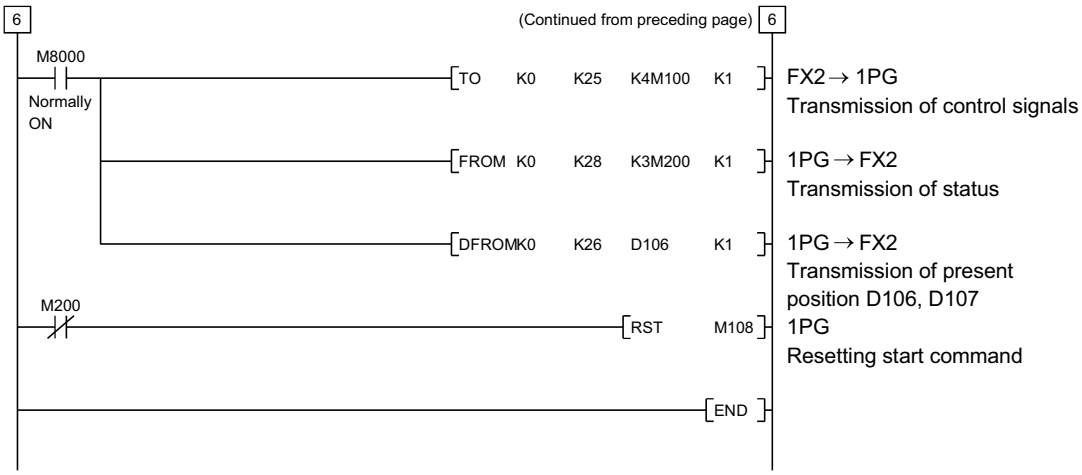

2
(Continued from preceding page)
2
X4
Alarm reset PB
M0
Error flag
Y3
Alarm reset output
Y3
Alarm reset
RST C1
Clearing retry counter
ZRST M0 M64
Clearing ABS data receiving area
ZRST D0 D3
Clearing ABS receive data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
X5
Emergency stop PB
M0
Error flag output
X3
Servo alarm
Y10
Servo alarm output
RST Y1
Resetting ABS transfer mode
RST Y2
Resetting ABS request
RST M99
Resetting ready to send
RST M5
Resetting servo-on request
RST M6
Resetting retry flag
Servo alarm detection, alarm reset control
M1
ABS data transmission start
SET Y1
ABS transfer mode ON
ZRST M10 M64
Clearing ABS data reception area
ZRST D0 D2
Clearing ABS receiver data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
ABS transfer mode Initial setting
3
(To be continued)
3


3
(Continued from preceding page)
3
Y1
X2
ABS transfer mode
Send data ready
PLS M3
Resetting ABS data
M3
ABS data read
SET Y2
ABS request ON
Y2
X2
ABS request
Send data ready
K1 T204
ABS data waiting timer 10ms
ABS data 32 bits (2 bits×16 times) + Check sum 6 bits (2 bits×3 times)
T204
ABS data waiting timer
WANDP K1X0 H0003 K1M10
Masking ABS data 2 bits
SFTR M10 M20 K38 K2
Right shift (2 bits) of ABS data
C2
ADDP K1M10 D2 D2
Check sum addition
K16 C2
Updating ABS data reception counter
K19 C0
Updating all data reception counter
RST Y2
Resetting ABS request
C0
All data reception counter
RST Y1
Resetting ABS transfer mode
WANDP H003F D2 D2
Masking check sum 6 bits
CMPP K2M52 D2 M62
Comparison of check sum
C1
Retry counter
Y12
ABS data check sum error
Detection of ABS check sum error, retry control
M62
>
C1
Retry counter
PLS M2
Retry command
M64
<
K10 T200
Setting retry wait timer: 100ms
MOV K2M52 D3
Storing check sum value in the case of check sum error
SET M6
Retry flag ON
RST M5
Resetting servo-on request
4
(To be continued)
4


4
(Continued from preceding page)
4
M63
Check sum match
DMOVP K8M20 D0
ABS data → D0, D1
DADDP D0 D24 D0
Adding 1PG home position address
DTOP K0 K26 D0 K1
ABS data → 1PG
SET M99
Setting ABS data ready
ZRST M62 M64
Clearing check sum judging area
RST M6
Resetting retry flag
Writing absolute position data to 1PG
Y11
ABS communi-cation error
X6
Servo-on PB
RST Y1
Detecting ABS communication error
RST Y2
Resetting ABS request
Y1
ABS transfer mode
K500 T201
ABS transfer mode 5s timer
Y1
ABS transfer mode
Y2
ABS request
K100 T202
ABS request response 1s timer
Y1
ABS transfer mode
X2
Send data ready
K100 T203
Ready to send response 1s timer
T201
ABS transmission NG
Y11
ABS communication error
T202
ABS request NG
T203
Send data ready NG
Detecting ABS communication error
M2
Retry command
D4 C1
Counting retry frequency
T200
Retry wait timer
M6
Retry
SET M5
Setting servo-on request
ABS transfer retry control
5
(To be continued)
5



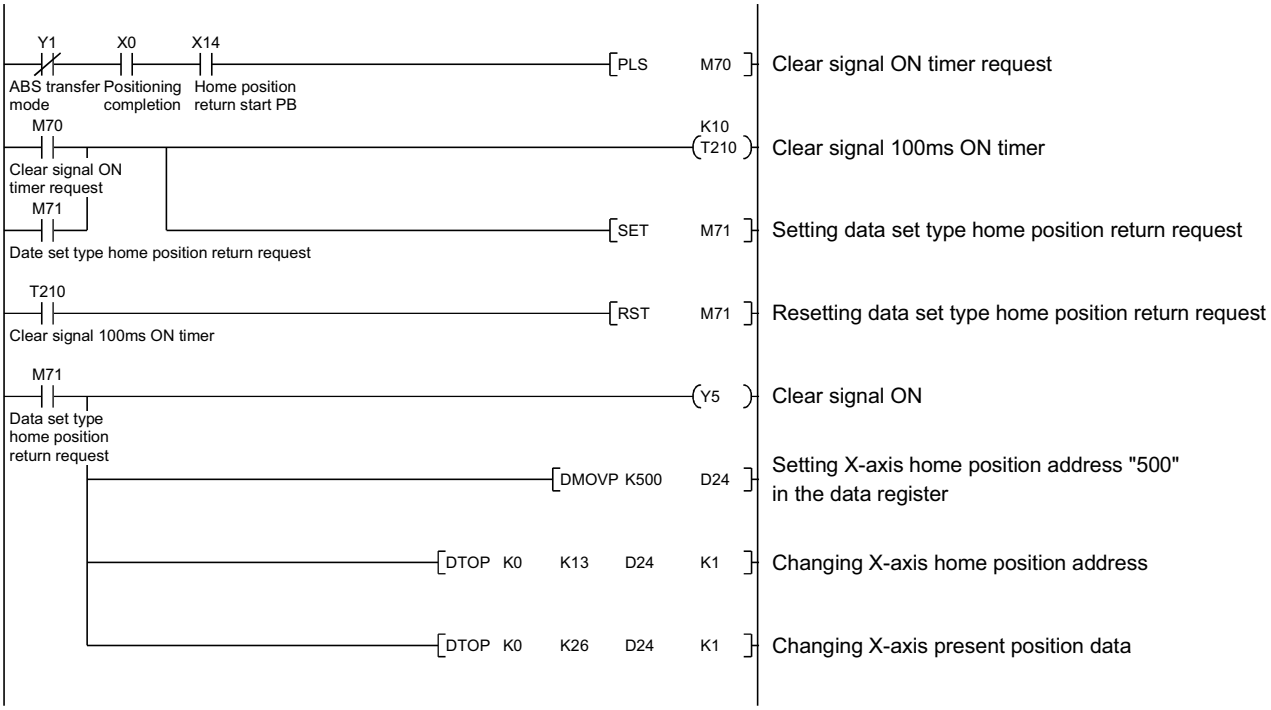
Note: Program example for the dog type home position return. For the data set type home position return, refer to the program example in (2), (d) in this section.



(d) Data set type home position return

After jogging the machine to the position where the home position (e.g.500) is to be set, choose the home position return mode set the home position with the home position return start (PBON). After switching power on, rotate the servo motor more than 1 revolution before starting home position return.

Do not turn ON the clear signal (Y5) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



(e) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

Set "1 □ 1 □" in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.

(f) Positioning completion

To create the status information for servo positioning completion.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

(g) Zero speed

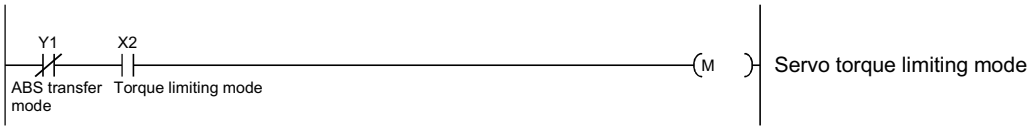
To create the status information for servo zero speed.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

(h) Torque limiting

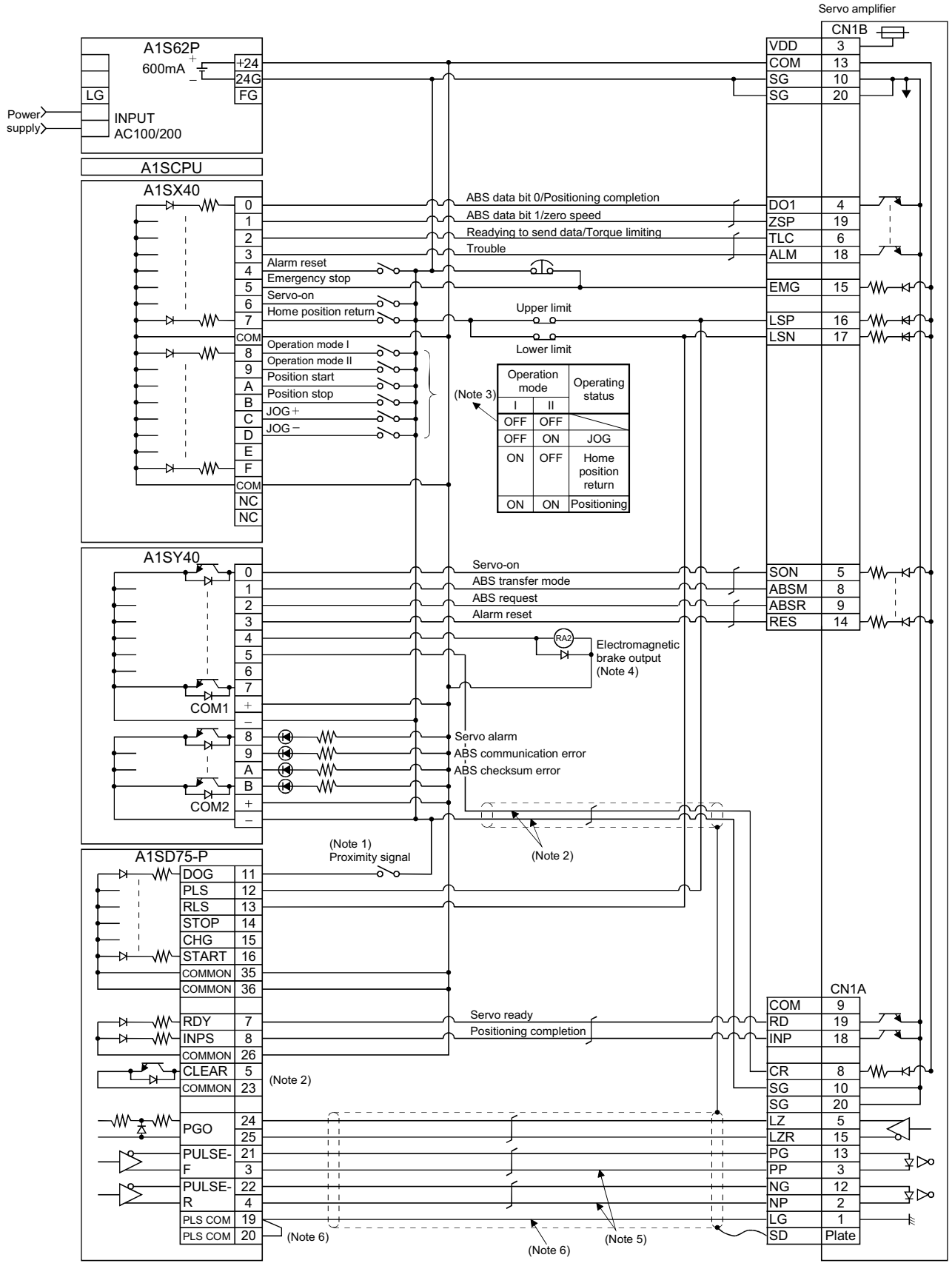
To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the torque limiting must be off.



15.8.3 MELSEC A1SD75(AD75)

(1) Connection diagram



Note 1: For the dog type home position return. Need not be connected for the data set type home position return.
2: If the servo motor provided with the zero point signal is started, the A1SD75(AD75) will output the deviation counter clear signal. Therefore, do not connect the clear signal of the MR-J2-A to the A1SD75(AD75) but connect it to the output module of the programmable controller.
3: This circuit is provided for your reference.
4: The electromagnetic brake output should be controlled via a relay connected to the programmable controller output.
5: Use the differential line driver system for pulse input. Do not use the open collector system.
6: To reinforce noise suppression, connect LG and pulse output COM.

(2) Sequence program example

(a) Conditions

1) When the servo-on signal and power supply GND are shorted, the ABS data is transmitted at power-on of the servo amplifier or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when an emergency stop is reset.

2) If a checksum mismatch is detected in the transmitted data, data transmission is retried up to three times. If the checksum mismatch still persists after the retries, the ABS checksum error occurs (Y3A ON).

3) The following time periods are measured. If the ON/OFF state does not change within the specified time, the ABS communication error occurs change within the specified time, the ABS communication error occurs (Y3A ON):
ON period of ABS transfer mode (Y31)
ON period of ABS request (Y32)
OFF period of reading to send ABS data (X22)

(b) Device list

X input contact		Y output contact	
X20	ABS bit 0 / positioning completion	Y30	Servo-on
X21	ABS bit 1 / zero speed	Y31	ABS transfer mode
X22	Reading to send ABS data / limiting torque	Y32	ABS request
X23	Servo alarm	Y33	Alarm reset
X24	Alarm reset	X34 (Note 2)	Electromagnetic brake output
X25	Servo emergency stop	Y35 (Note 1)	Clear
X26	Servo-on	Y38	Servo alarm
X27	Home position return start 2)	Y39	ABS communication error
X28	Operation mode I	Y3A	ABS checksum error
X29	Operation mode II		
1)	D register		M contact
D0	ABS data transmission counter	M5	ABS data transmission start
D1	Checksum transmission counter	M6	Sum check completion
D2	Checksum addition register	M7	Sum check mismatch
D3	ABS data: Lower 16 bits	M8	ABS data ready
D4	ABS data: Upper 16 bits	M9	Transmission data read enabled
D5	ABS data 2-bit receiving buffer	M10	Checksum 2 bits read completion
D6	Check data in case of checksum error 4)	M11	ABS 2 bits read completion
D7	Number of retries	M12	ABS 2 bits request
D8	Forward rotation direction	M13	Servo-on request
D9	Home position address: Lower 16 bits	M14	Servo alarm
D10	Home position address: Upper 16 bits	M15	ABS data transmission retry start pulse
D11	Drive unit ready data	M16	Retry flag set
D12	Home position return completion data	M17	Retry flag reset
D110	Received shift data: Lower 16 bits	M18	PLS processing command
D111	Received shift data: Upper 16 bits	M20 (Note 1)	Clear signal ON timer request
3)	T timer	M21 (Note 1)	Data set type home position return request
T0	ABS transmission mode timer	M22	Home position return processing instruction
T1	ABS request response timer		
T2	Retry wait timer	M23	Current position change processing instruction
T3	ABS data send reading response timer		
T10 (Note 1)	Clear signal ON timer	M24	Current position change flag
T200	Transmitted data read 10ms delay timer	C counter	
		C0	ABS data receive times counter
		C1	Checksum receive times counter
		C2	Retry counter

Note: 1.Required for data set type home position return.
2.Required for electromagnetic brake output.

(c) ABS data transfer program for X axis

This sequence program example assumes the following conditions:

・Parameters of the A1SD75-P1 (AD75-P1) positioning module

1) Unit setting :3 = pulse (PLS)

2) Travel per pulse :1 = 1 pulse

To select the unit other than the pulse, conversion into the unit of the feed value per pulse is required. Hence, add the following program to the area marked (Note) in the sequence program:

<Additional program>

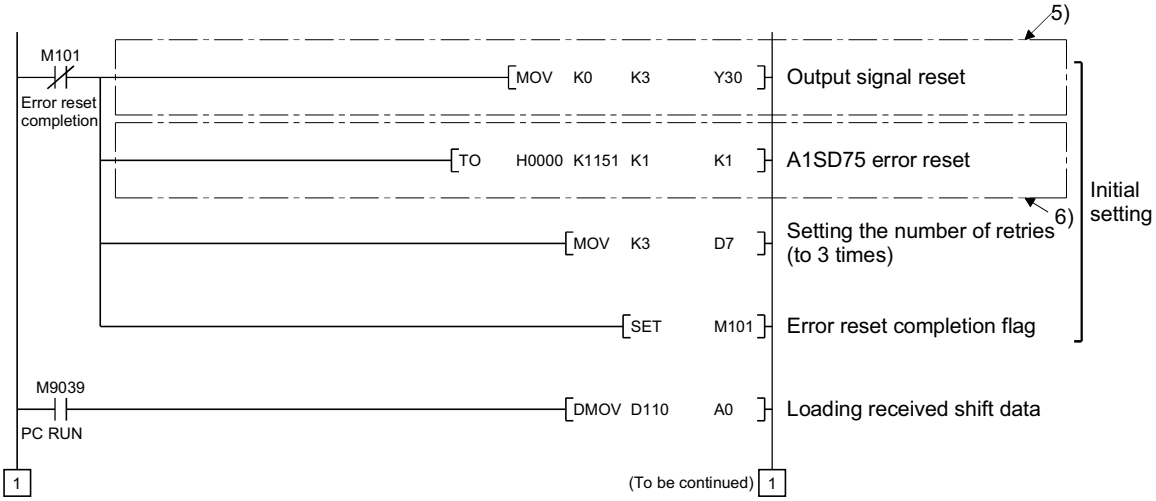
Item	mm				inch				degree				pulse
Unit setting	0				1				2				3
Travel per pulse	0.1 to	1 to	10 to	100	0.00001 to	0.0001 to	0.001 to	0.01 to	0.00001 to	0.0001 to	0.001 to	0.01 to	
Unit of travel	μm/PLS				inch/PLS				degree/PLS				PLS
Constant K for conversion into unit of travel	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	None

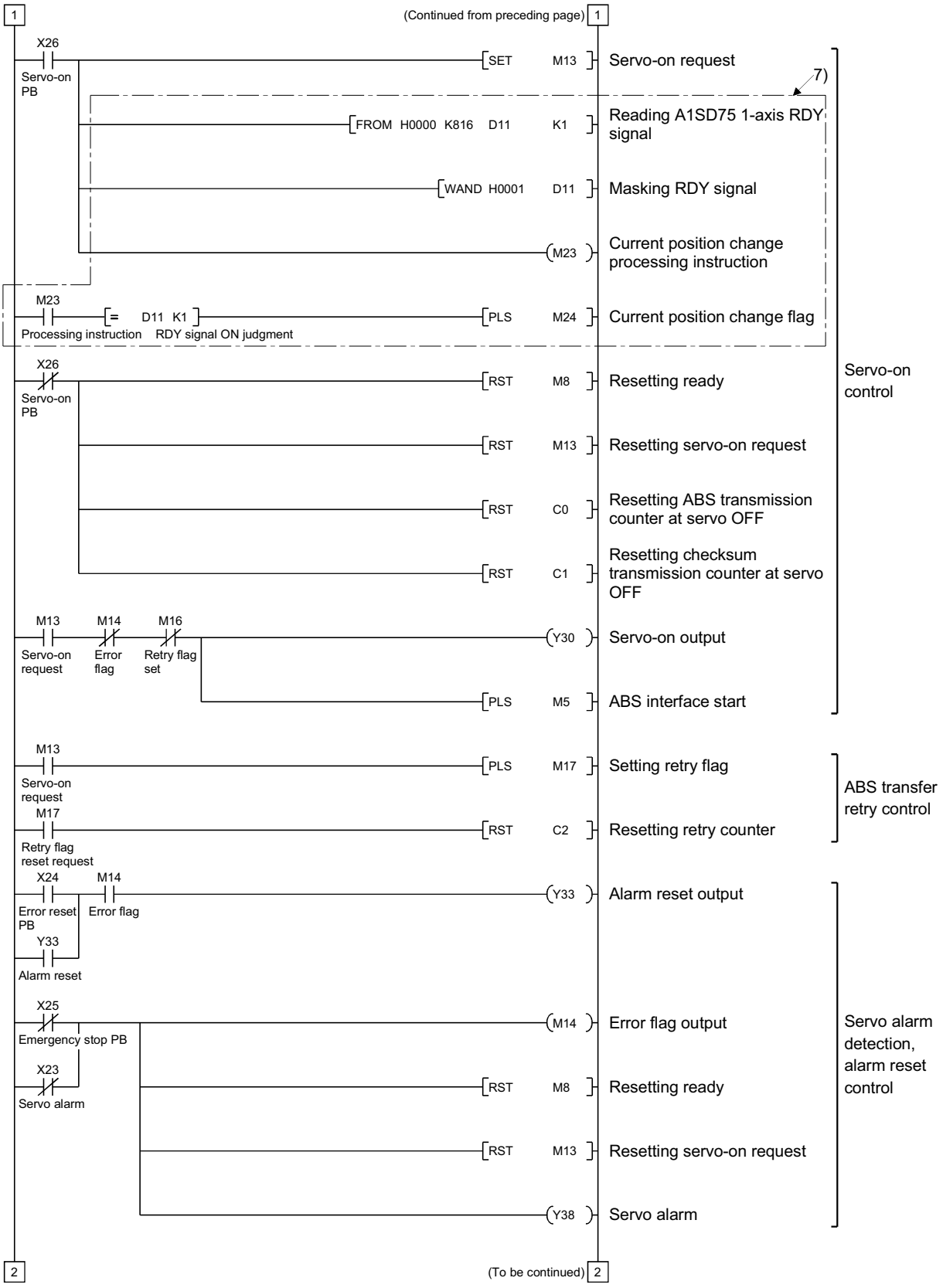
Reference

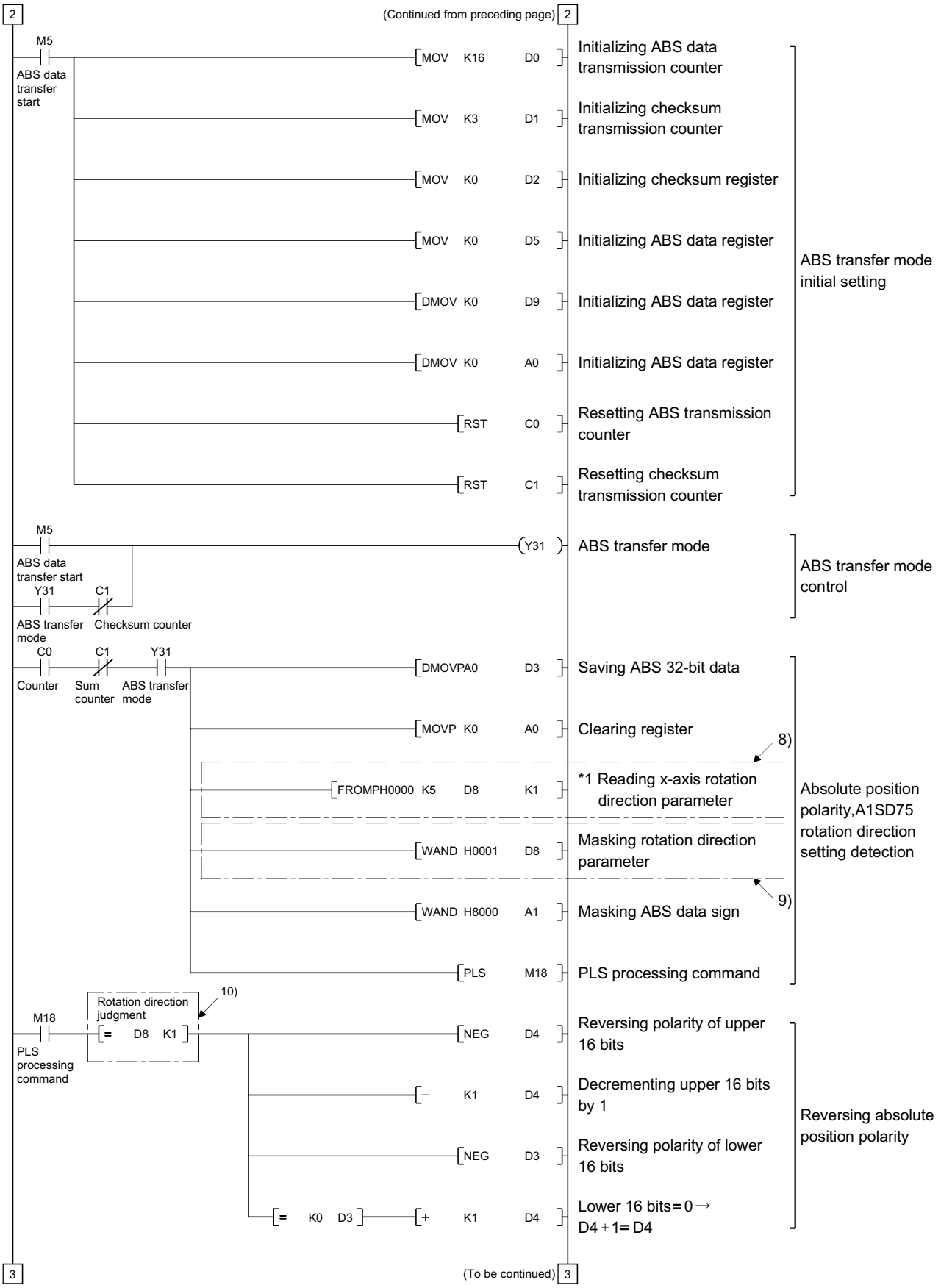
・For 1μm/PLS, set constant K to 10

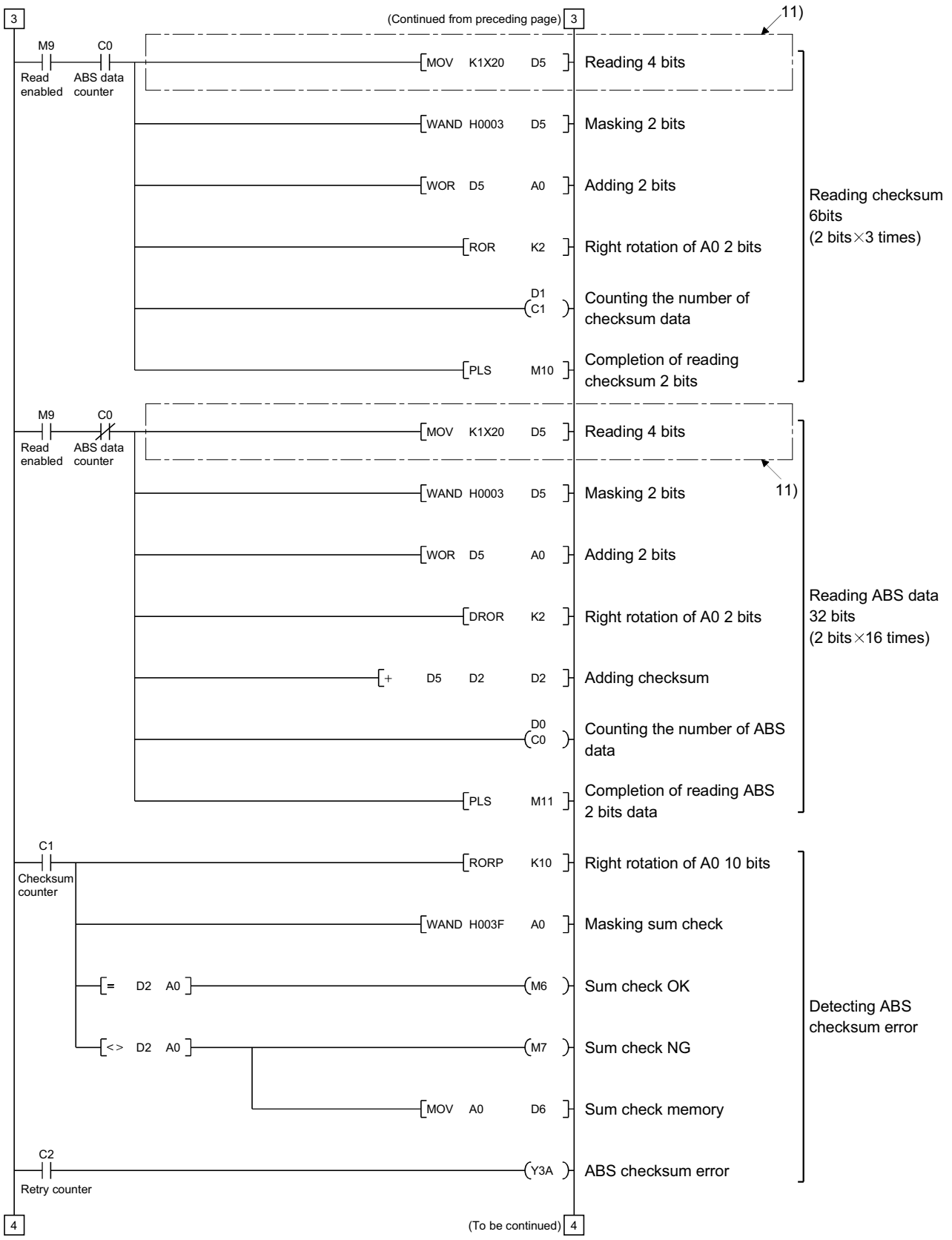
・For 5μm/PLS, set constant K to 50

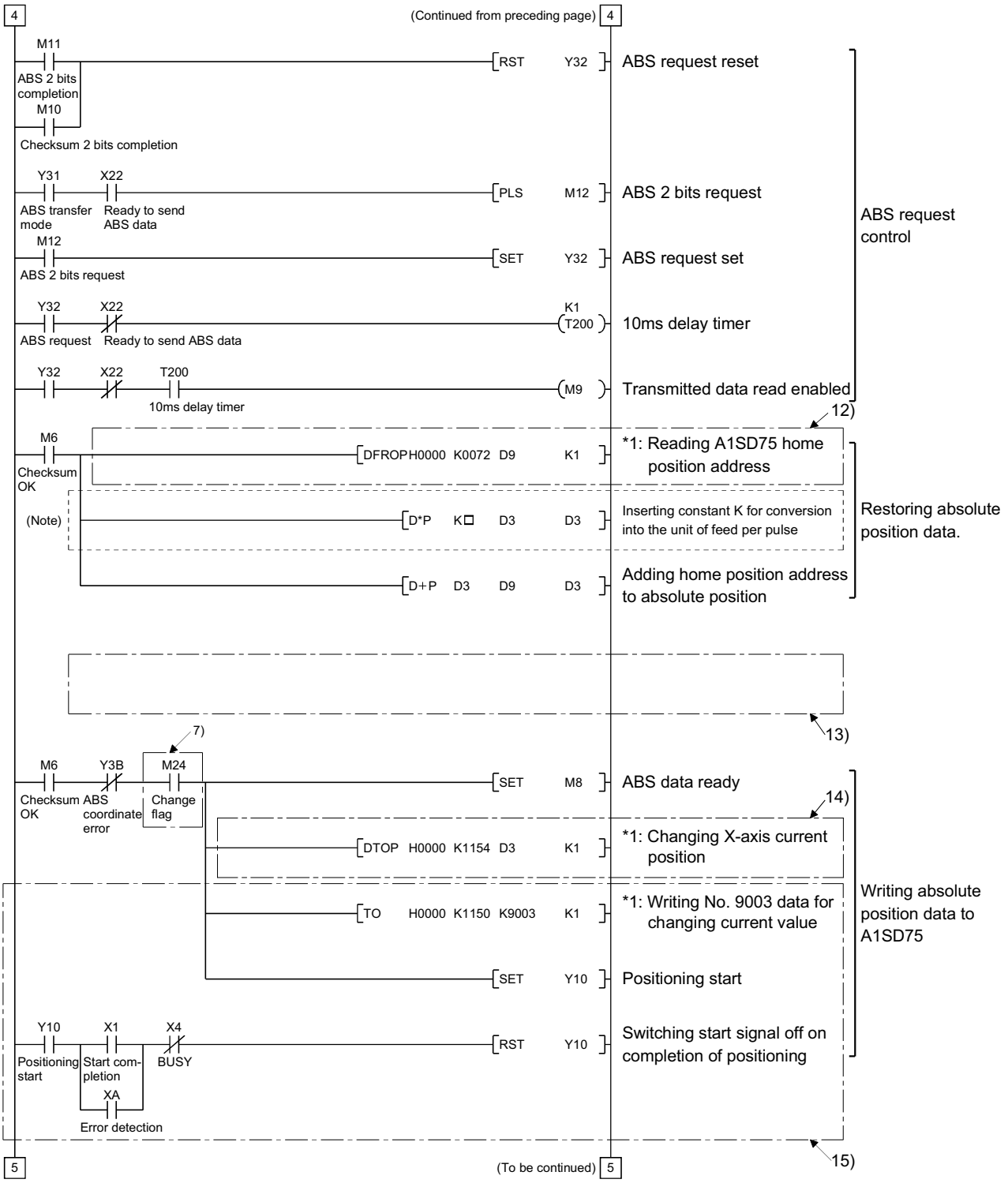
・The additional program is not required for the unit setting is PLS.



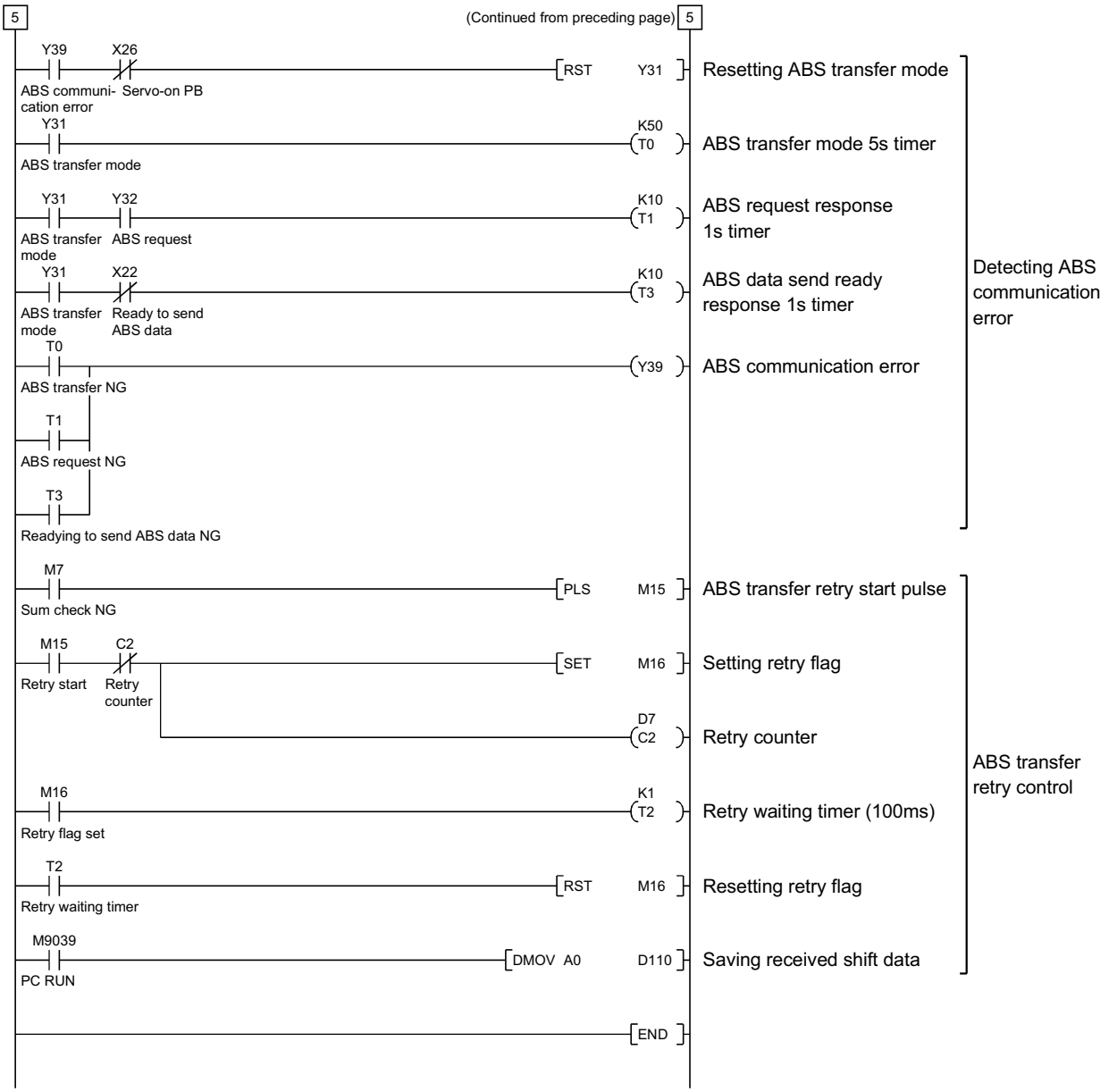

1
(Continued from preceding page)
1
X26
Servo-on PB
SET M13
Servo-on request
7)
FROM H0000 K816 D11 K1
Reading A1SD75 1-axis RDY signal
WAND H0001 D11
Masking RDY signal
M23
Current position change processing instruction
M23
Processing instruction
= D11 K1
RDY signal ON judgment
PLS M24
Current position change flag
X26
Servo-on PB
RST M8
Resetting ready
RST M13
Resetting servo-on request
RST C0
Resetting ABS transmission counter at servo OFF
RST C1
Resetting checksum transmission counter at servo OFF
Servo-on control
M13
Servo-on request
M14
Error flag
M16
Retry flag set
Y30
Servo-on output
PLS M5
ABS interface start
M13
Servo-on request
PLS M17
Setting retry flag
M17
Retry flag reset request
RST C2
Resetting retry counter
ABS transfer retry control
X24
Error reset PB
M14
Error flag
Y33
Alarm reset output
Y33
Alarm reset
X25
Emergency stop PB
M14
Error flag output
X23
Servo alarm
RST M8
Resetting ready
RST M13
Resetting servo-on request
Y38
Servo alarm
Servo alarm detection, alarm reset control
2
(To be continued)
2


2
(Continued from preceding page)
2
M5
ABS data transfer start
MOV K16 D0
Initializing ABS data transmission counter
MOV K3 D1
Initializing checksum transmission counter
MOV K0 D2
Initializing checksum register
MOV K0 D5
Initializing ABS data register
DMOV K0 D9
Initializing ABS data register
DMOV K0 A0
Initializing ABS data register
RST C0
Resetting ABS transmission counter
RST C1
Resetting checksum transmission counter
ABS transfer mode initial setting
M5
ABS data transfer start
Y31
ABS transfer mode
ABS transfer mode control
Y31 C1
ABS transfer mode
Checksum counter
C0 C1 Y31
Counter
Sum counter
ABS transfer mode
DMOVPA0 D3
Saving ABS 32-bit data
MOVP K0 A0
Clearing register
8)
FROMPH0000 K5 D8 K1
*1 Reading x-axis rotation direction parameter
WAND H0001 D8
Masking rotation direction parameter
9)
WAND H8000 A1
Masking ABS data sign
PLS M18
PLS processing command
Absolute position polarity,A1SD75 rotation direction setting detection
10)
Rotation direction judgment
M18
= D8 K1
PLS processing command
NEG D4
Reversing polarity of upper 16 bits
− K1 D4
Decrementing upper 16 bits by 1
NEG D3
Reversing polarity of lower 16 bits
= K0 D3
+ K1 D4
Lower 16 bits=0→ D4+1=D4
Reversing absolute position polarity
3
(To be continued)
3


3
(Continued from preceding page)
3
11)
M9
Read enabled
C0
ABS data counter
MOV K1X20 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
ROR K2
Right rotation of A0 2 bits
D1 C1
Counting the number of checksum data
PLS M10
Completion of reading checksum 2 bits
Reading checksum 6bits (2 bits×3 times)
M9
Read enabled
C0
ABS data counter
MOV K1X20 D5
Reading 4 bits
11)
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
DROR K2
Right rotation of A0 2 bits
+ D5 D2 D2
Adding checksum
D0 C0
Counting the number of ABS data
PLS M11
Completion of reading ABS 2 bits data
Reading ABS data 32 bits (2 bits×16 times)
C1
Checksum counter
RORP K10
Right rotation of A0 10 bits
WAND H003F A0
Masking sum check
= D2 A0
M6
Sum check OK
<> D2 A0
M7
Sum check NG
MOV A0 D6
Sum check memory
Detecting ABS checksum error
C2
Retry counter
Y3A
ABS checksum error
4
(To be continued)
4

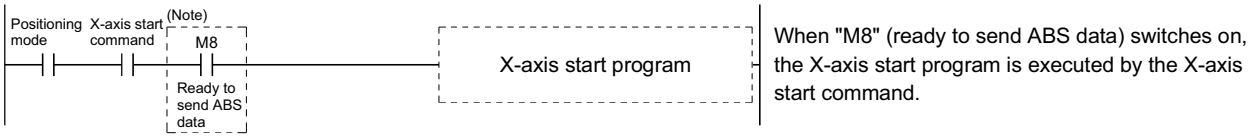


Note: When the unit setting parameter value of the AD75 positioning module is changed from "3" (pulse) to "0" (mm), the unit is $\times 0.1\mu$m for the input value. To set the unit to $\times 1\mu$m, add this program to multiple the feed value by 10.


5
(Continued from preceding page)
5
Y39
X26
RST
Y31
Resetting ABS transfer mode
ABS communi- cation error
Servo-on PB
Y31
K50
T0
ABS transfer mode 5s timer
ABS transfer mode
Y31
Y32
K10
T1
ABS request response 1s timer
ABS transfer mode
ABS request
Y31
X22
K10
T3
ABS data send ready response 1s timer
ABS transfer mode
Ready to send ABS data
T0
Y39
ABS communication error
ABS transfer NG
T1
ABS request NG
T3
Readying to send ABS data NG
Detecting ABS communication error
M7
PLS
M15
ABS transfer retry start pulse
Sum check NG
M15
C2
SET
M16
Setting retry flag
Retry start
Retry counter
D7
C2
Retry counter
M16
K1
T2
Retry waiting timer (100ms)
Retry flag set
T2
RST
M16
Resetting retry flag
Retry waiting timer
M9039
DMOV A0
D110
Saving received shift data
PC RUN
ABS transfer retry control
END

(d) X-axis program

Do not execute the X-axis program while the ABS ready (M8) is off.

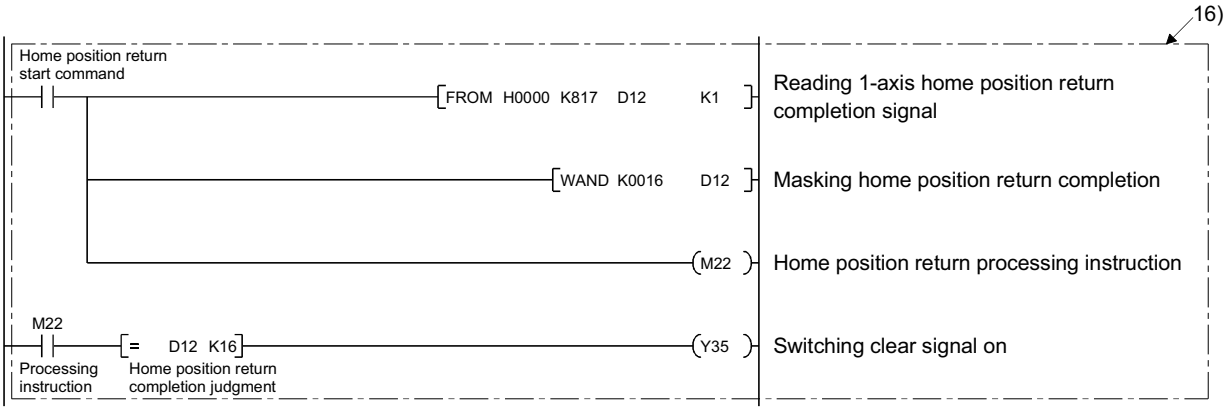


(e) Dog type home position return

Refer to the home position return program in the A1SD75 User's Manual.

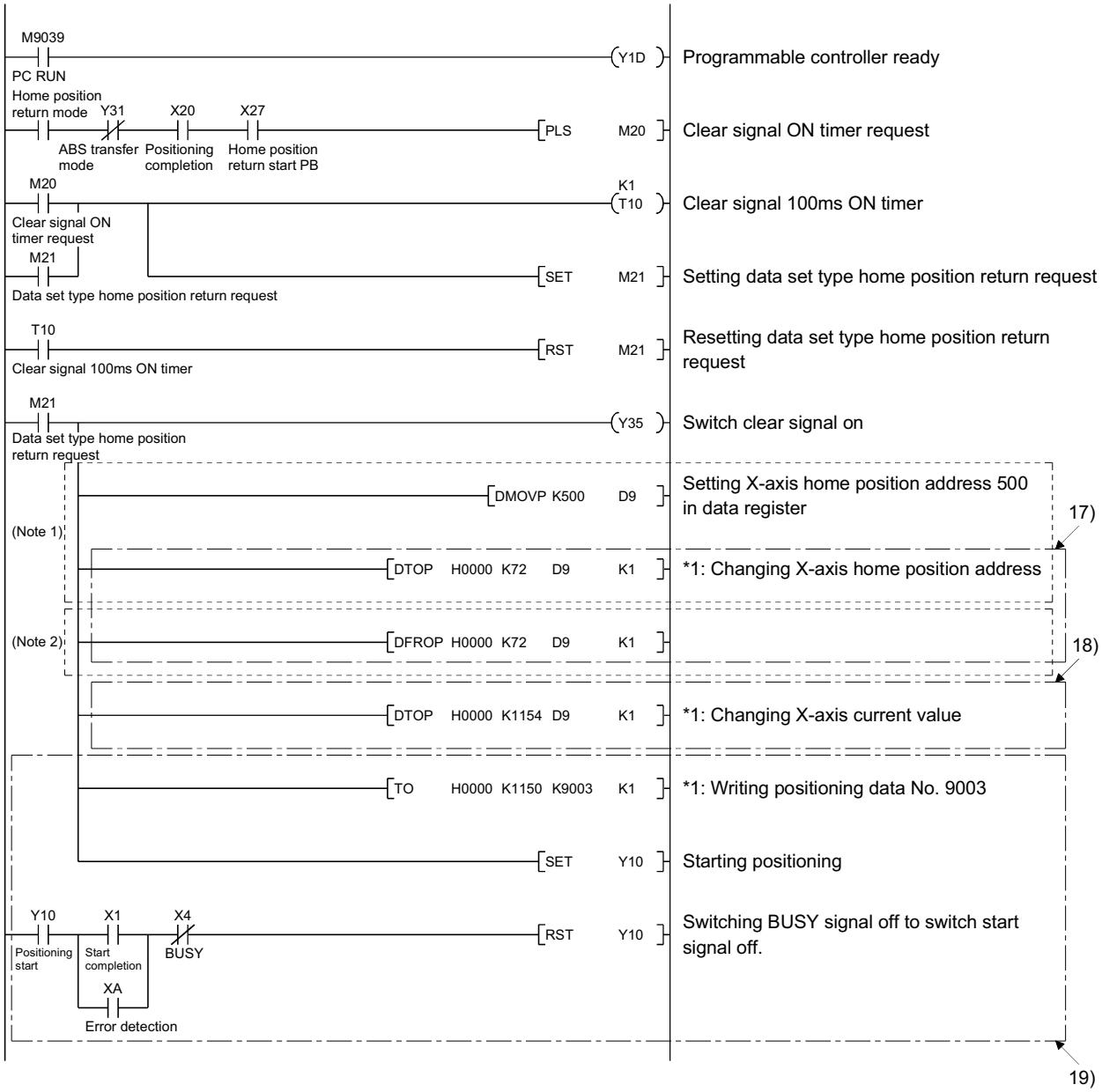
Note that this program requires a program which outputs the clear signal (Y35) after completion of home position return.

Add the following program:



(f) Data set type home position return

After jogging the machine to the position where the home position (e.g. 500) is to be set, choose the home position return mode and set the home position with the home position return start (PBON).
After switching power on, rotate the servo motor more than 1 revolution before starting home position return.
Do not turn ON the clear signal (Y35) for an operation other than home position return. Turning it on in other circumstances will cause position shift.



Note 1: If the data of the home position address parameter is not written from the A7PHP programming tool or the like before starting the data set type home position return program, this sequence circuit (Note 1) is required and the sequence circuit (Note 2) is not required.

2: Contrary to above 2, if the home position address is written in the home position address parameter, the sequence circuit (Note1) is not required but this sequence circuit (Note 1) is required.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

Set "1□1□" in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.

(h) Positioning completion

To create the status information for servo positioning completion.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

(i) Zero speed

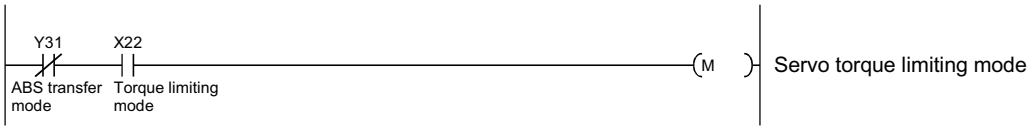
To create the status information for servo zero speed.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

(j) Torque limiting

To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the torque limiting must be off.



(3) Sequence program - 2-axis control

The following program is a reference example for creation of an ABS sequence program for the second axis (Y axis) using a single A1SD75 module. Create a program for the third axis in a similar manner.

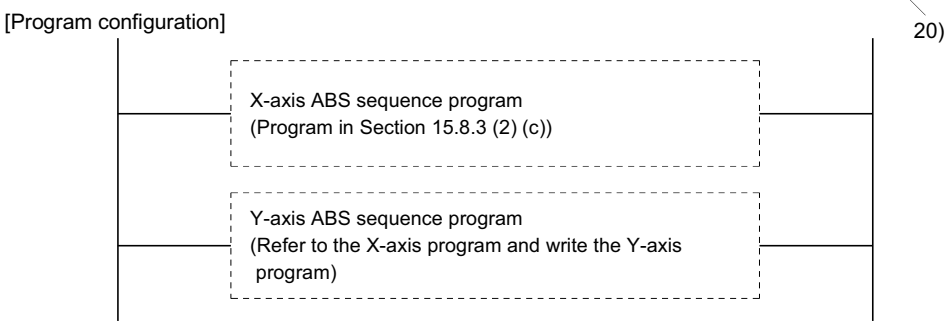
(a) Y-axis program

Refer to the X-axis ABS sequence program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts, T timers and C counters of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of Section 15.8.3 (2), (c) should be changed as indicated below for use with the Y axis:

```
[FROMP H0000 K5    D8    K1]   →   [FROMP H0000 K155 D8    K1]
[DFROP H0000 K0072 D9    K1]   →   [DFROP H0000 K222  D9    K1]
[DTOP  H0000 K1154 D3    K1]   →   [DTOP  H0000 K1204 D3    K1]
[TO    H0000 K1150 K9003 K1]   →   [TO    H0000 K1200 K9003 K1]
                                                          20)
```



(b) Data set type home position return

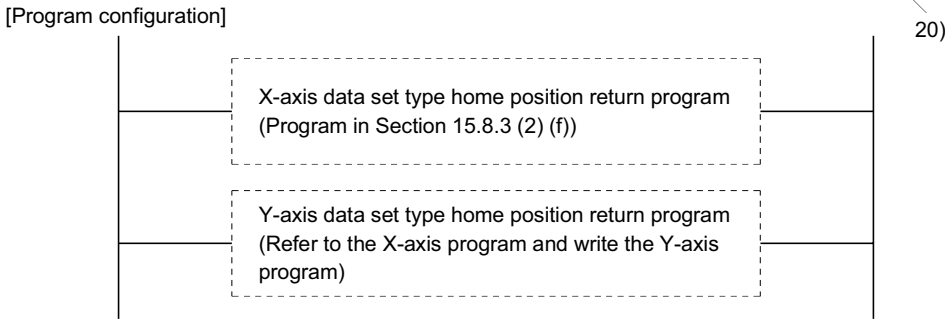
Arrange the data set type home position return programs given in Section 15.8.3 (2), (f) in series to control two axes.

Refer to the X-axis data set type home position return program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts and T timers of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of Section 15.8.3 (2), (f) should be changed as indicated below for use with the Y axis:

```
[DTOP  H0000 K72   D9    K1]   →   [DTOP  H0000 K222  D9    K1]
[DTOP  H0000 K1154 D9    K1]   →   [DTOP  H0000 K1204 D3    K1]
[TO    H0000 K1150 K9003 K1]   →   [TO    H0000 K1200 K9003 K1]
                                                          20)
```



(4) Differences between A1SD75 (AD75) and A1SD71 (AD71)

The sequence programs shown in (2) of this section differ from those for the A1SD71 (AD71) in the following portions. 1) to 20) in the following sentences indicate the numbers in the programs given in (2) of this section.

(a) Devices used

Since the A1SD75 (AD75) is a one-slot module which occupies 32 I/O points, the I/O devices are different, as indicated by 1) and 2), from those of the two-slot A1SD71 which occupies 48 point. The A1SD75 (AD75) uses the devices indicated in the following table, and its D registers and M contacts are different as indicated by 3) and 4).

Device name	Devices			Application	Bit device :Data at ON Data register :Stored data
	Axis 1	Axis 2	Axis 3		
Input	X0			AD75 ready	Not ready/ WDT error
	X4	X5	X6	BUSY	BUSY(running)
	XA	XB	XC	Error detection	Error detection
Output	Y10	Y11	Y12	Positioning start	Start being requested
	Y13	Y14	Y1C	Axis stop	Stop being requested
	Y16	Y18	Y1A	Forward rotation jog start	Forward rotation being started
	Y17	Y19	Y1B	Reverse rotation jog start	Reverse rotation being started
	Y1D			Programmable controller ready	Programmable controller CPU normal
internal relay	M0			Parameter setting completion flag	Setting complete
	M1			Flash ROM registration processing flag	Processing
	M2	M3	M4	Axis error reset requesting flag	Requesting
	M100			AD75 normal flag	AD75 normal
	M101			Initial error reset completion flag	Error reset complete
	M102			All BUSY signal OFF flag	All BUSY signal OFF
	M103			AD75 operable flag	Operable
Data register	D100			Flash ROM registration results	Registration results
	D101	D102	D103	Axis error code	Error code
	D104	D105	D106	Axis warning code	Warning code
	D107	D108	D109	Axis error reset results	Axis error reset results

(b) ABS sequence program example

1) Initial setting

To reset the error of the A1SD75, the program 5) is added to reset all output signals at start-up. The axis error reset buffer memory address is changed from 201 to 1154 (axis 1) and the slot number from H0001 (slot number 1) to H0000 (slot number 2) 6).

2) Absolute position polarity, A1SD75 rotation direction setting detection

The slot number and buffer memory of the X-axis rotation direction parameter reading area are changed from [FROMP H0001 K7872 D8 K1] to [FROMP H0000 K5 D8 K1] 8).

The rotation direction parameter masking area is changed from [WAND H0004 D8] to [WAND H0001 D8] 9).

3) Reversing absolute position polarity

The rotation direction judging area is changed from [= D8 K4] to [= D8 K1] 10).

4) Reading checksum 6 bits, reading ABS data 32 bits

The 4 bits reading area is changed from [MOV K1 X30D5] to [MOV K1X20 D5] 11).

5) Restoring absolute position data

The slot number and buffer address of the A1SD75 home position address reading area are changed from [DFROP H0001 K7912 D9 K1] to [DFROP H0000 K72 D9 K1] 12)

6) Writing absolute position data to A1SD75
The slot number and buffer address of the X-axis current value changing area are changed from [DTOP H0001 K41 D3 K1] to [DTOP H0000 K1154 D3 K1] 14). When the current value is changed in the A1SD75, the current feed value is changed at the start of positioning data No.9003. Therefore, the starting program for positioning data No.9003 15) is added.

7) X-axis data set type home position return program
The slot numbers and buffer addresses of the X-axis home position address changing area are changed from [DTOP H0001 K7912 D9 K1] to [DTOP H0000 K72 D9 K1] and from [DFROP H0001 K7912 D9 K1] to [DFROP H0000 K72 D9 K1] 17).
The slot number and buffer address of the X-axis current value changing area are changed from [DTOP H0001 K41 D3 K1] to [DTOP H0000 K1154 D3 K1] 18). When the current value is changed in the A1SD75, the current feed value is changed at the start of positioning data No.9003. Therefore, the starting program for positioning data No.9003 19) is added.

8) Y-axis sequence program, Y-axis data set type home position return program.
The slot numbers and buffer addresses are changed as indicated by 20).

9) Writing absolute position data to AD75
The A1SD75 (AD75) allows the current position to be changed only when the ready signal of the Servo amplifier is on. Therefore, if the CPU scan is fast, the program for A1SD71 may change the current position before the ready signal switches on. 7) is added because the current position must be changed after it has been confirmed that the drive unit ready signal of the A1SD75 (D75) has switched on/off.

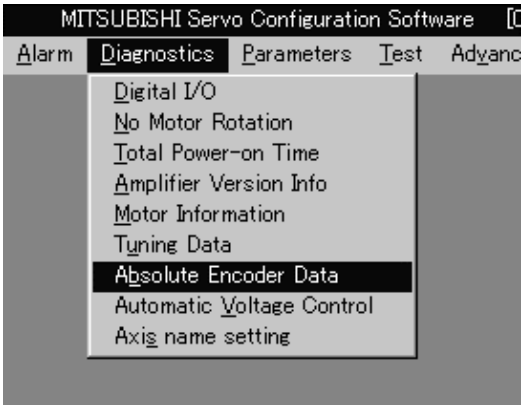
10) ABS coordinate error detection
As the A1SD75 (AD75) can handle the negative-polarity coordinate position that the A1SD71 could not handle, the program for ABS coordinate error detection is deleted. 13)

11) Dog type home position return program
Due to the changes in wiring described in (4), (a), 4) of this section, the program for outputting the clear signal (Y35) after completion of a home position return is required. 16)

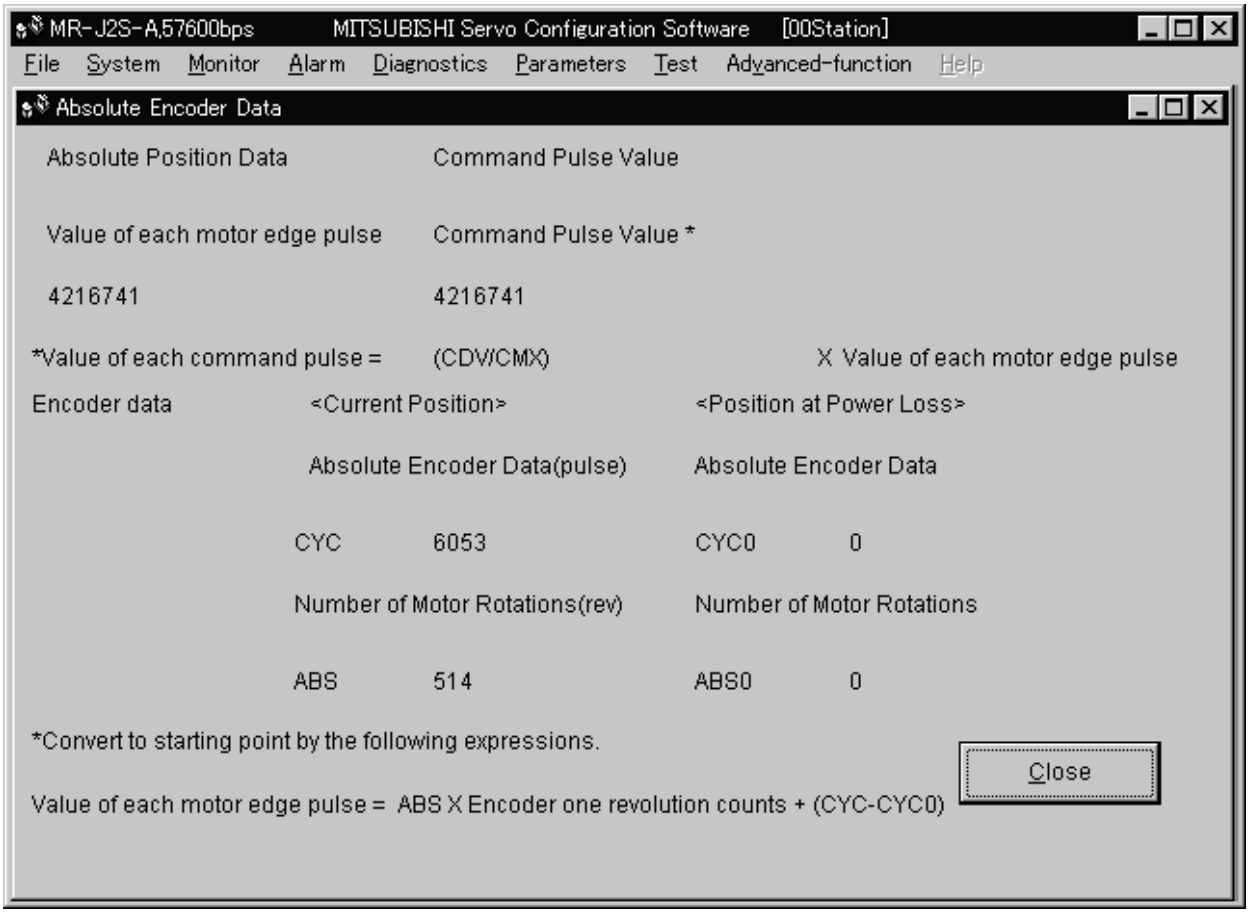
15.9 Confirmation of absolute position detection data

You can confirm the absolute position data with servo configuration software (MRZJW3-SETUP121E). Choose "Diagnostics" and "Absolute Encoder Data" to open the absolute position data display screen.

(1) Choosing "Diagnostics" in the menu opens the sub-menu as shown below:



(2) By choosing "Absolute Encoder Data" in the sub-menu, the absolute encoder data display window appears.



(3) Press the "Close" button to close the absolute encoder data display window.

15.10 Absolute position data transfer errors

15.10.1 Corrective actions

(1) Error list

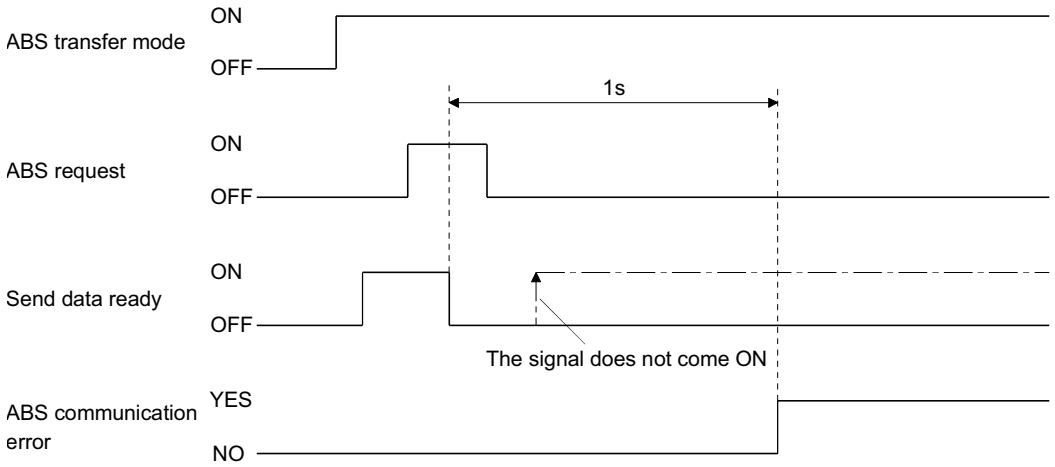
The number within parentheses in the table indicates the output coil or input contact number of the A1SD71 (AD71).

Name	Output coil		Description	Cause	Action
	AD71	1PG			
(Note) ABS communication error	Y49	Y11	1. The ABS data transfer mode signal (Y41) is not completed within 5s. 2. The ready to send signal (X32) is not turned OFF within 1s after the ABS data request signal (Y42) is turned ON. 3. The ready to send signal (X32) remains OFF for longer than 1s.	1. Wiring for ABS transfer mode signal, ABS data request signal, or ready to send signal is disconnected or connected to the SG terminal.	Correct the wiring.
				2. PC ladder program wrong.	Correct the ladder.
				3. Faulty PLC output or input module.	Change the input or output module.
				4. Faulty printed board in the servo amplifier.	Change the amplifier
				5. Power supply to the servo amplifier is OFF.	Turn on the power to the servo amplifier.
ABS data check sum error	Y4A	Y12	・ABS data sumcheck resulted in mismatch four times consecutively.	1. Wiring for the ABS data signal (ABS bit 0 (PF), bit 1 (ZSP)) is disconnected or connected to the SG terminal.	Correct the wiring.
				2. PC ladder program wrong.	Correct the ladder.
				3. Faulty PLC input module.	Change the input module.
				4. Faulty printed board in the servo amplifier.	Change the amplifier.
ABS coordinate error	Y4B		・The motor position is in the negative coordinate value range when the servo is turned ON or when power supply is turned ON.	1. The servo is turned ON or the power supply is turned ON near the machine home position or in the zone in which addresses decrease.	1. Reconsider the position where the servo is turned ON. 2. Set the home position for positioning apart from the machine home position.
				2. The machine falls on a vertical axis when the servo signal is turned ON/OFF.	Change the electromagnetic brake operation sequence.
Servo alarm	Y48	Y10	・Alarm occurred in the servo amplifier.	1. Emergency stop (EMG) of the servo amplifier was turned off.	After ensuring safety, turn EMG on.
				2. Trouble (ALM) of the servo amplifier was turned on.	Refer to Section 10.2.2 and take action.

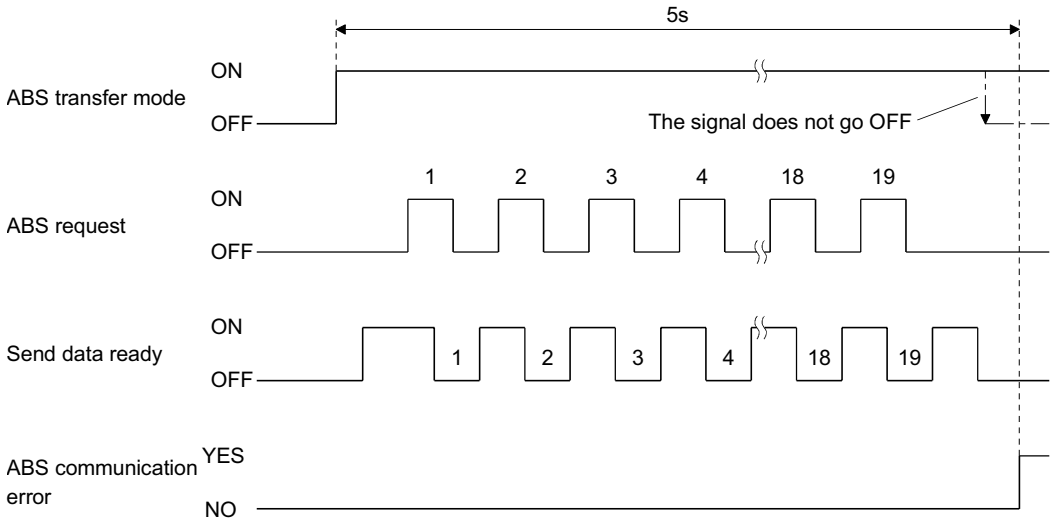
Note: Refer to (2) in this section for details of error occurrence definitions.

(2) ABS communication error

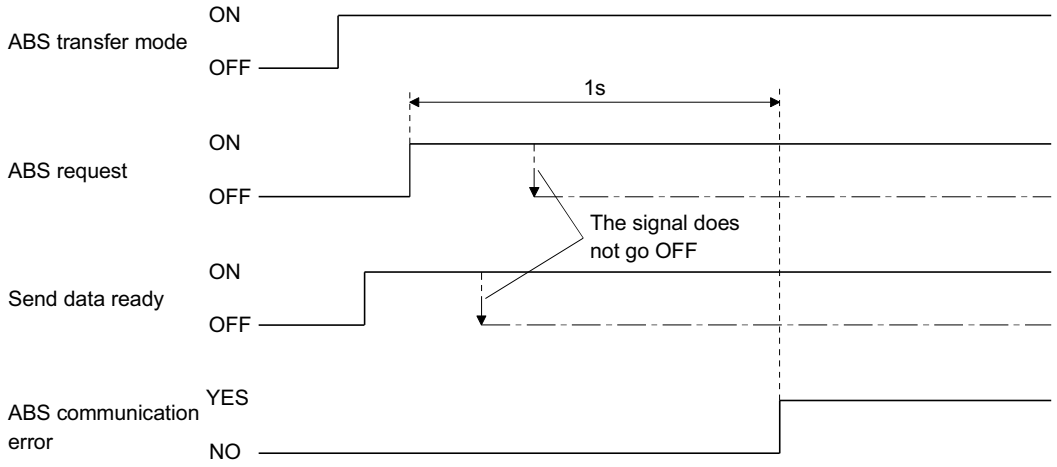
(a) The OFF period of the send data ready signal output from the servo amplifier is checked.
If the OFF period is 1s or longer, this is regarded as a transfer fault and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (AL.E5) is generated at the servo amplifier due to an ABS request ON time time-out.



(b) The time required for the ABS transfer mode signal to go OFF after it has been turned ON (ABS transfer time) is checked.
If the ABS transfer time is longer than 5s, this is communication error occurs if the ABS time-out warning (AL.E5) is generated at the servo amplifier due to an ABS transfer mode completion time time-out.



(c) To detect the ABS time-out warning (AL.E5) at the servo amplifier, the time required for the ABS request signal to go OFF after it has been turned ON (ABS request time) is checked. If the ABS request remains ON for longer than 1s, it is regarded that an fault relating to the ABS request signal or the send data ready signal has occurred, and the ABS communication error is generated. The ABS communication error occurs if the ABS time-out warning (AL.E5) is generated at the servo amplifier due to an ABS request OFF time time-out.



15.10.2 Error resetting conditions

Always remove the cause of the error before resetting the error.

Name	Output coil		Servo status	Resetting condition
	AD71	1PG		
ABS communication error	Y49	Y11	Ready (RD) signal off	Reset when servo-on PB (X36) signal turns off.
ABS checksum error	Y4A	Y12	Ready (RD) signal on	For AD71 Reset when servo-on PB (X36) signal turns from off to on.
				For FX-1PG Reset when servo-on PB (X36) signal turns off.
ABS coordinate error	Y4B		Ready (RD) signal on	Reset when servo-on PB (X36) signal turns from off to on after a motion to (+) coordinate is made by jog operation.
Servo alarm	Y48	Y10	Ready (RD) signal on	Reset when alarm reset PB turns on or power switches from off to on.

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